

FIG. 1

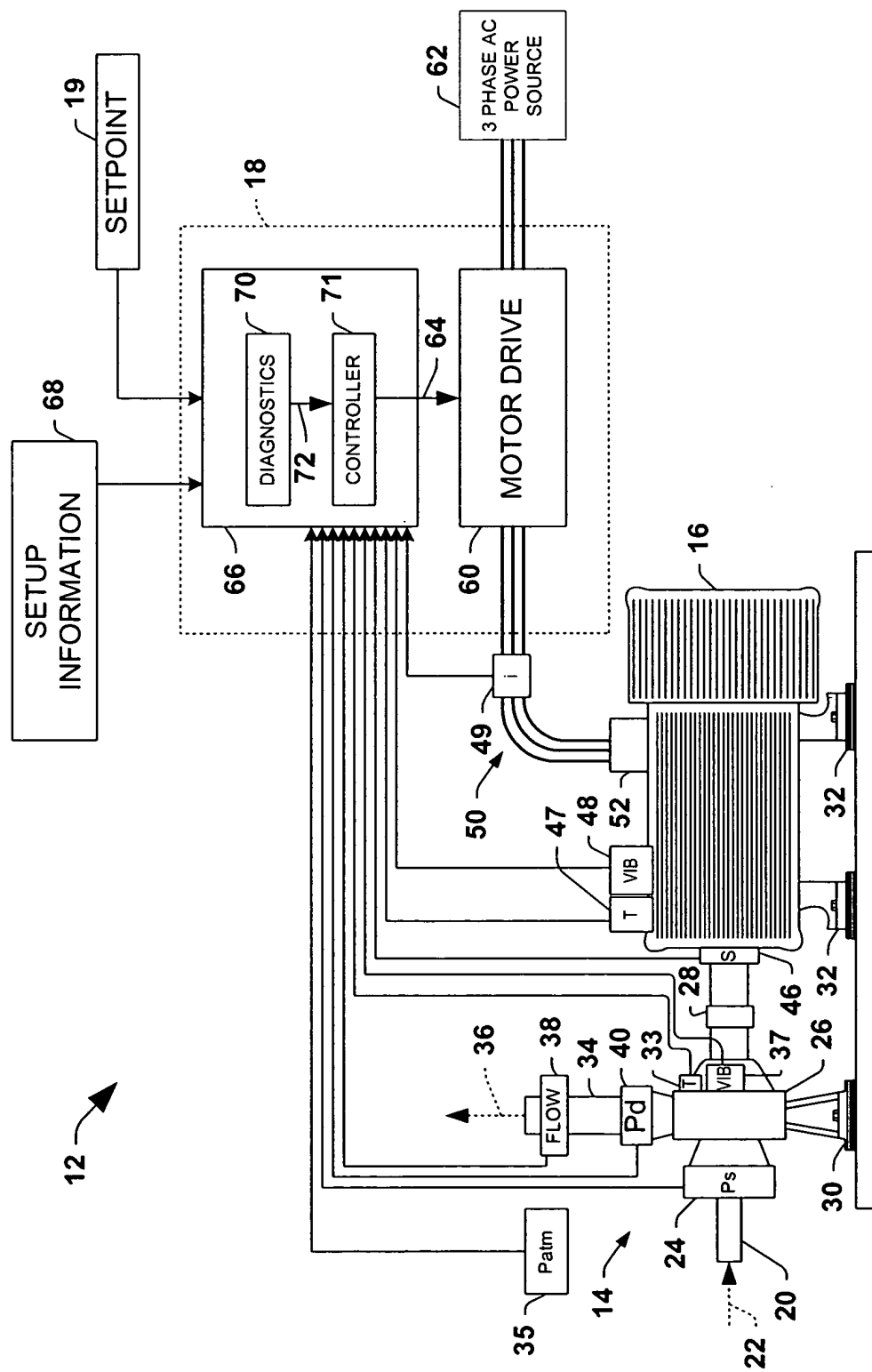


FIG. 2a

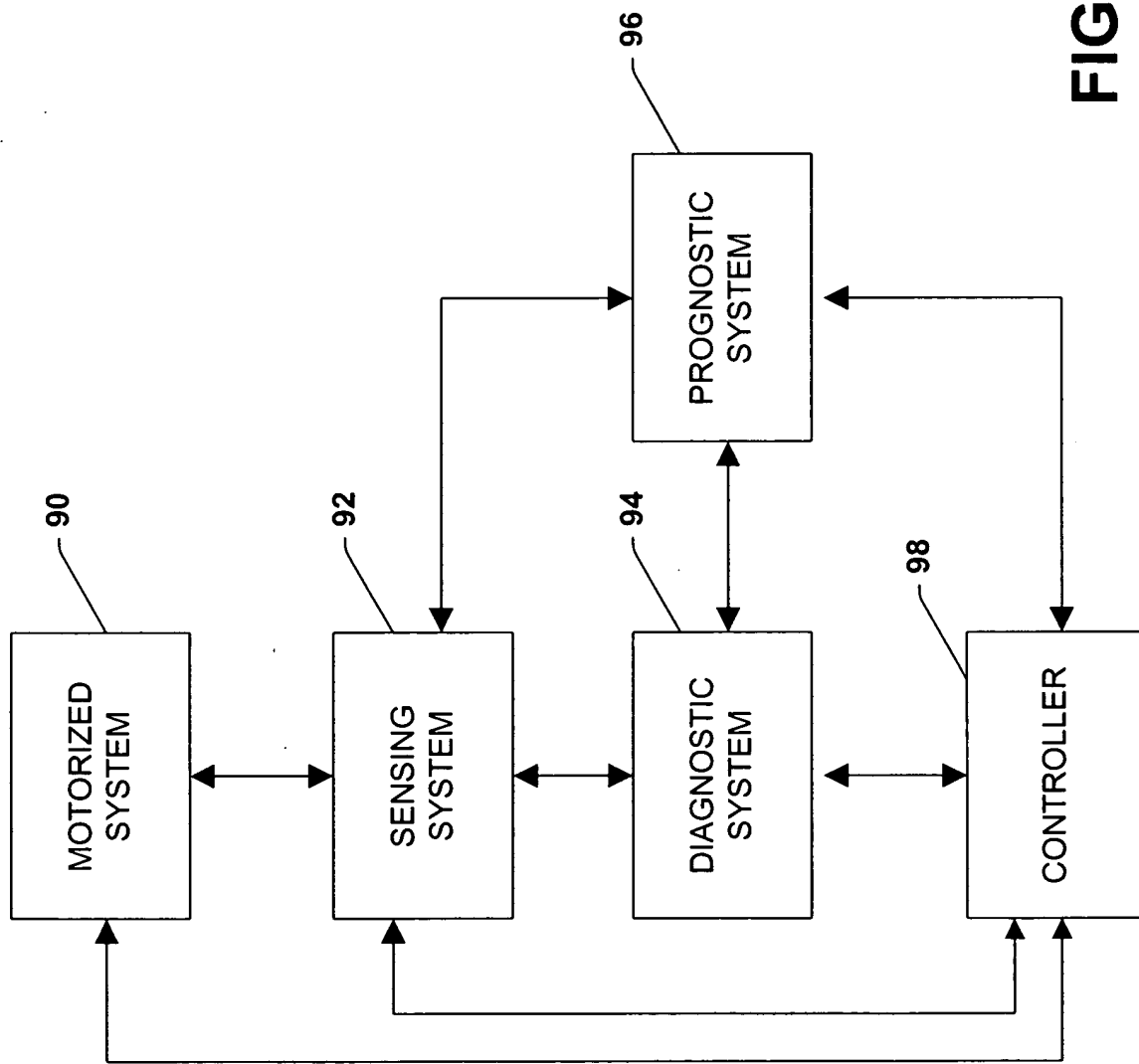


FIG. 2b

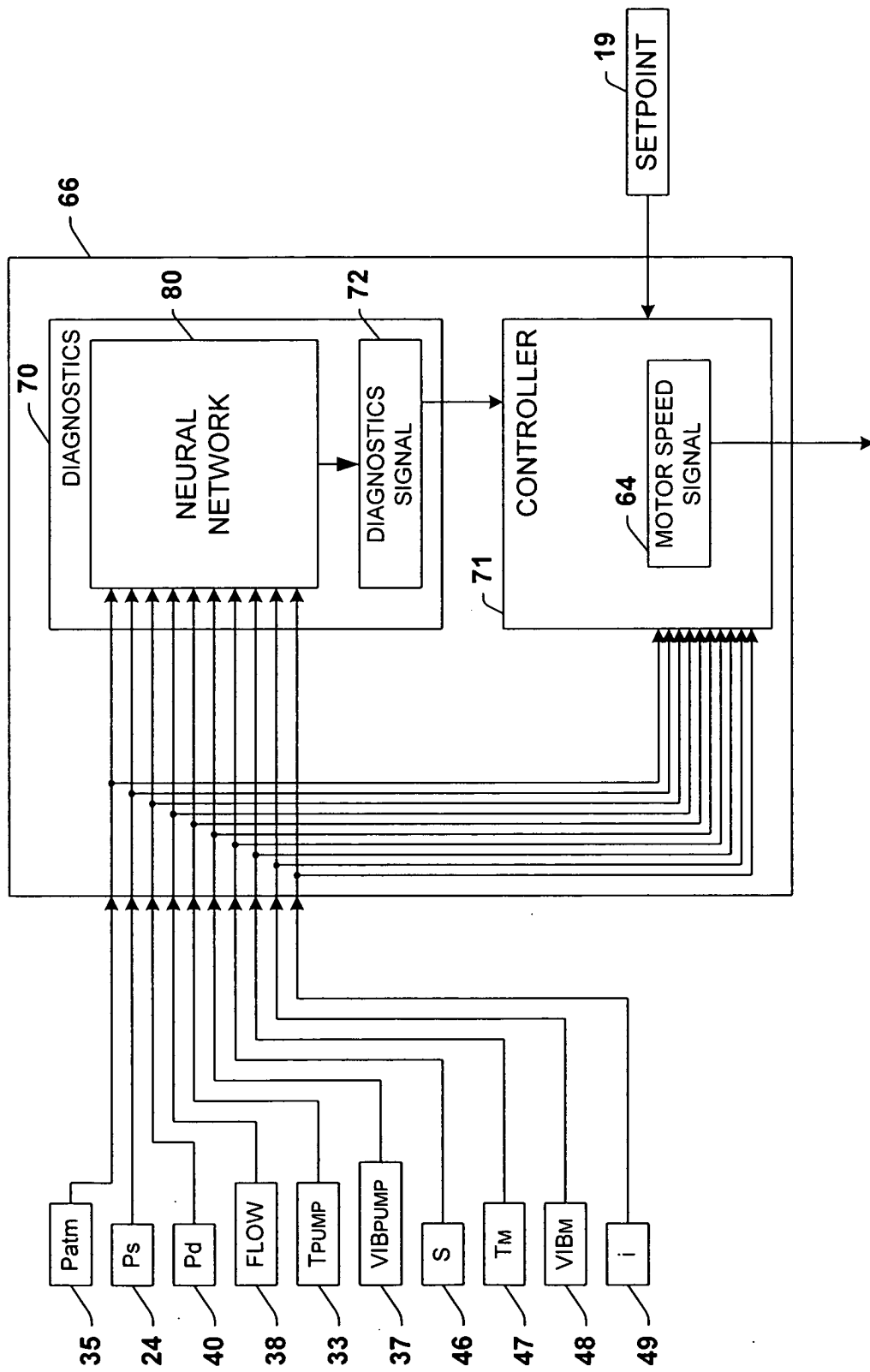


FIG. 3

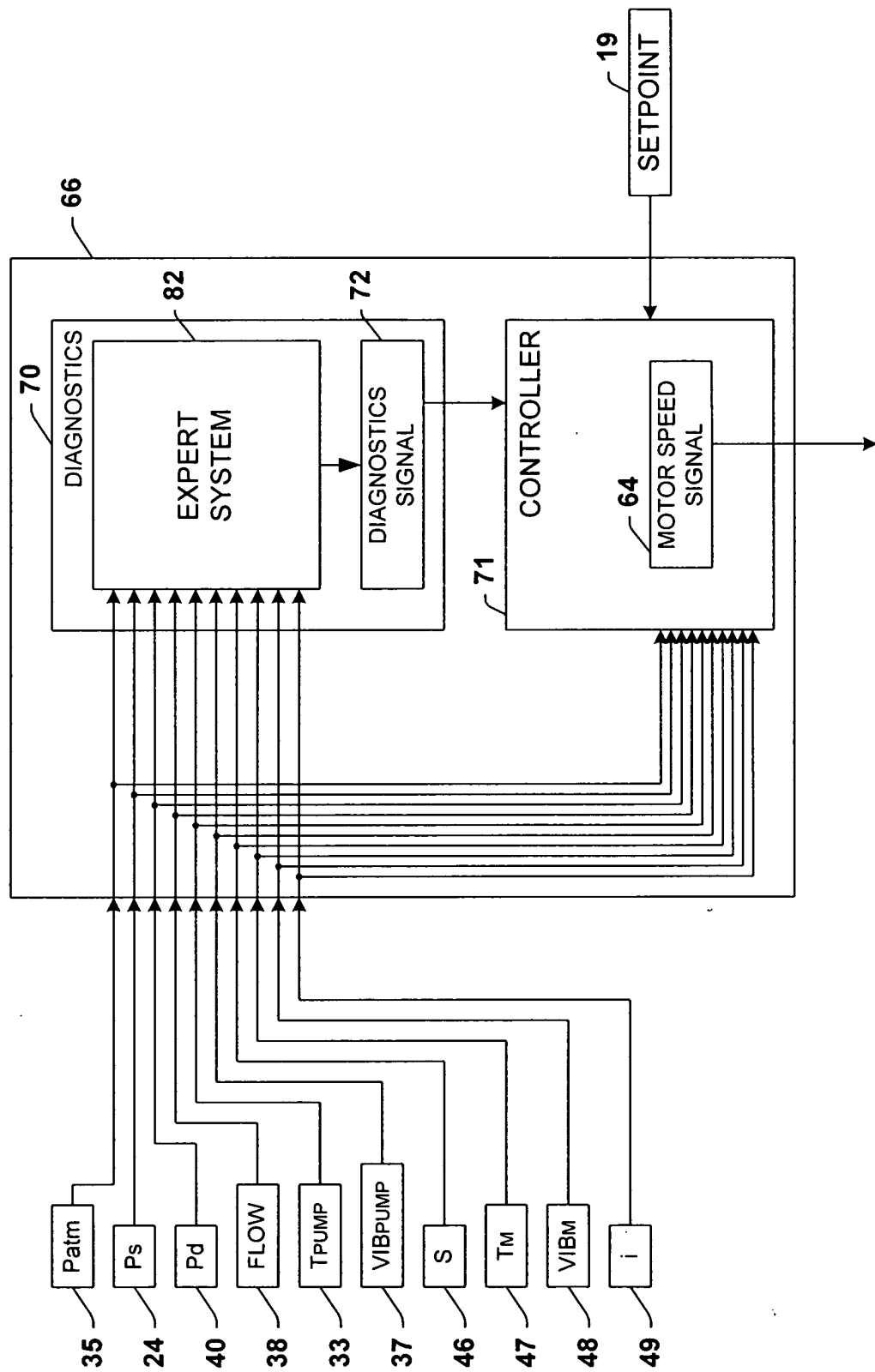


FIG. 4

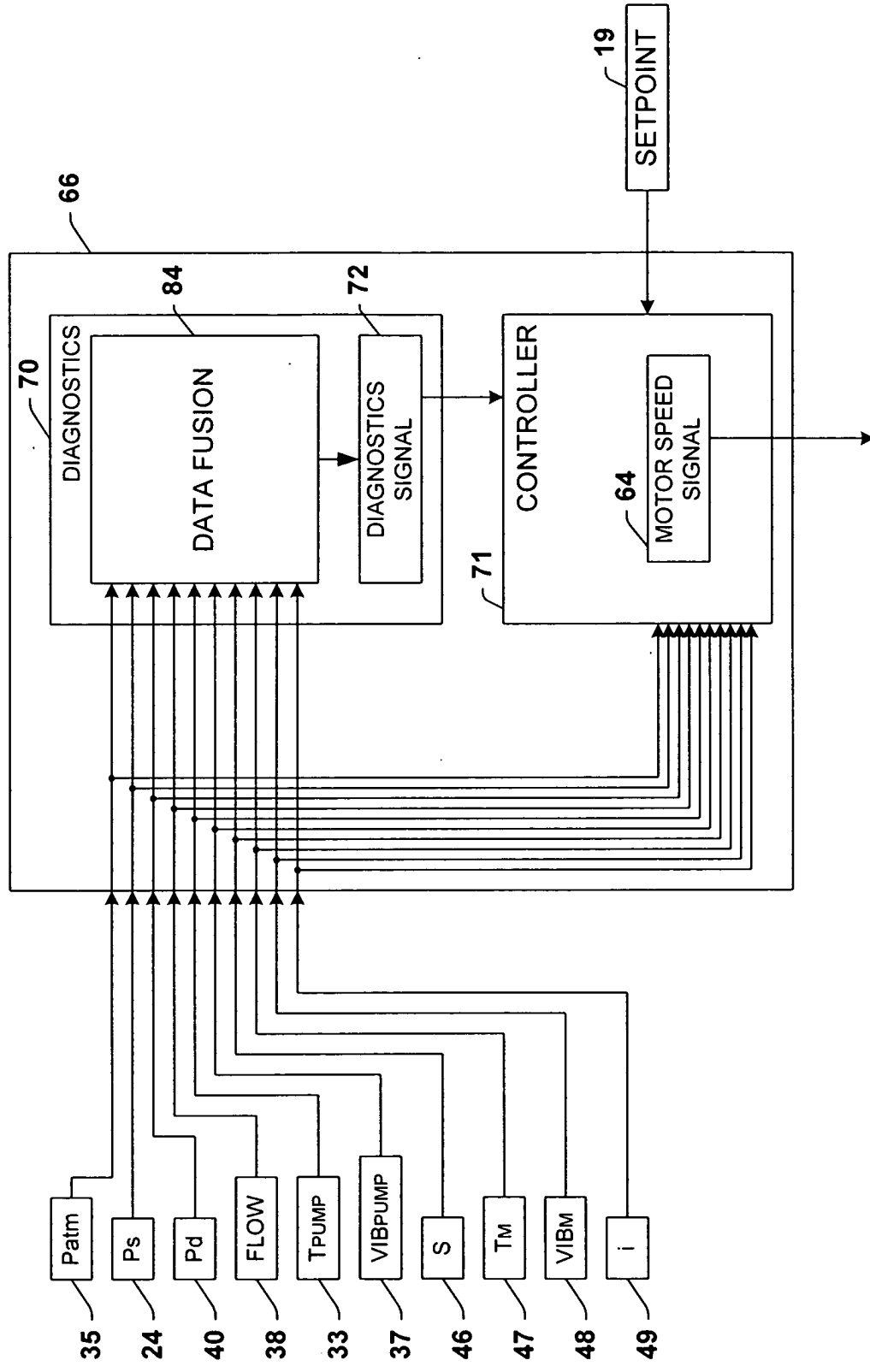
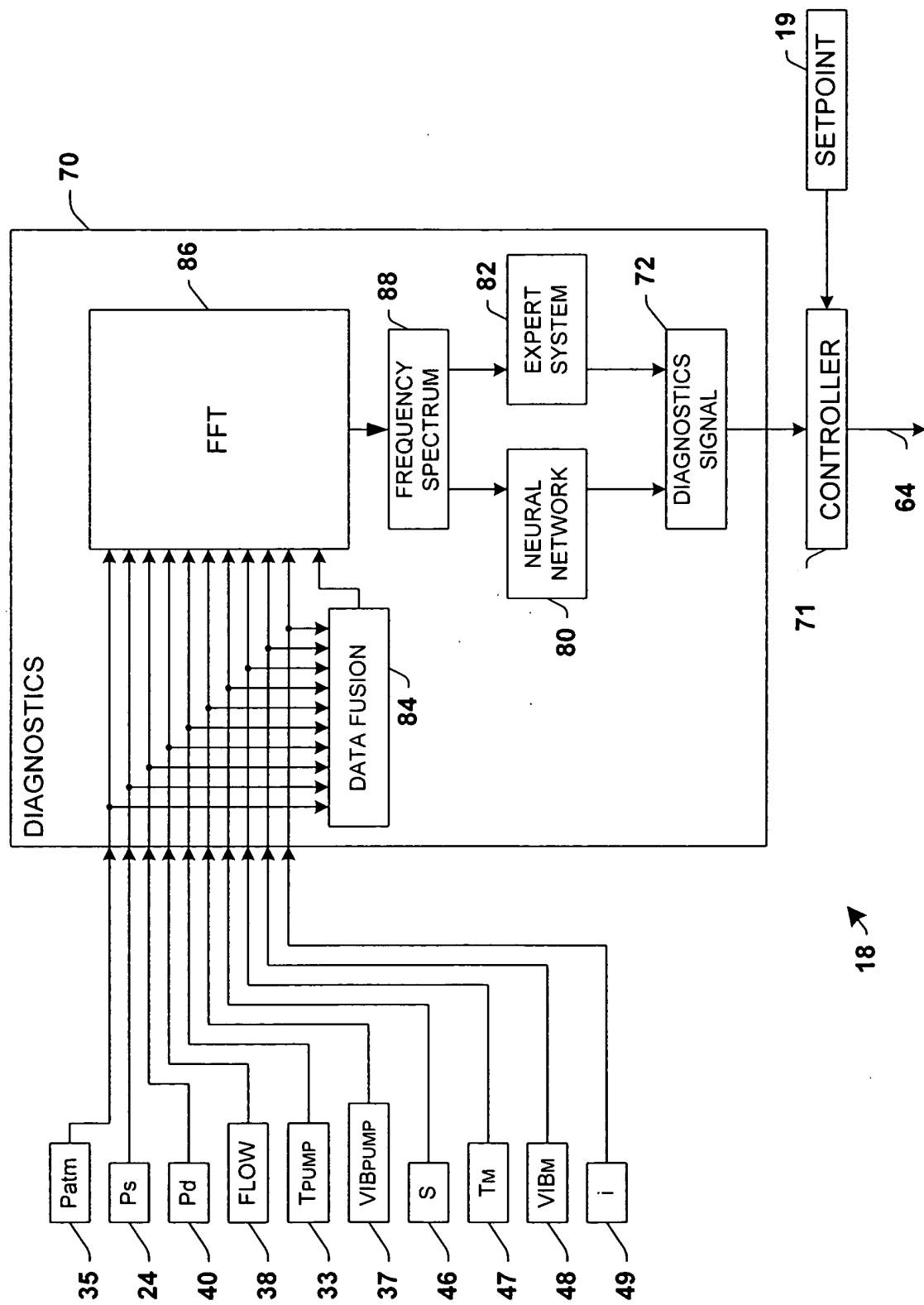


FIG. 5



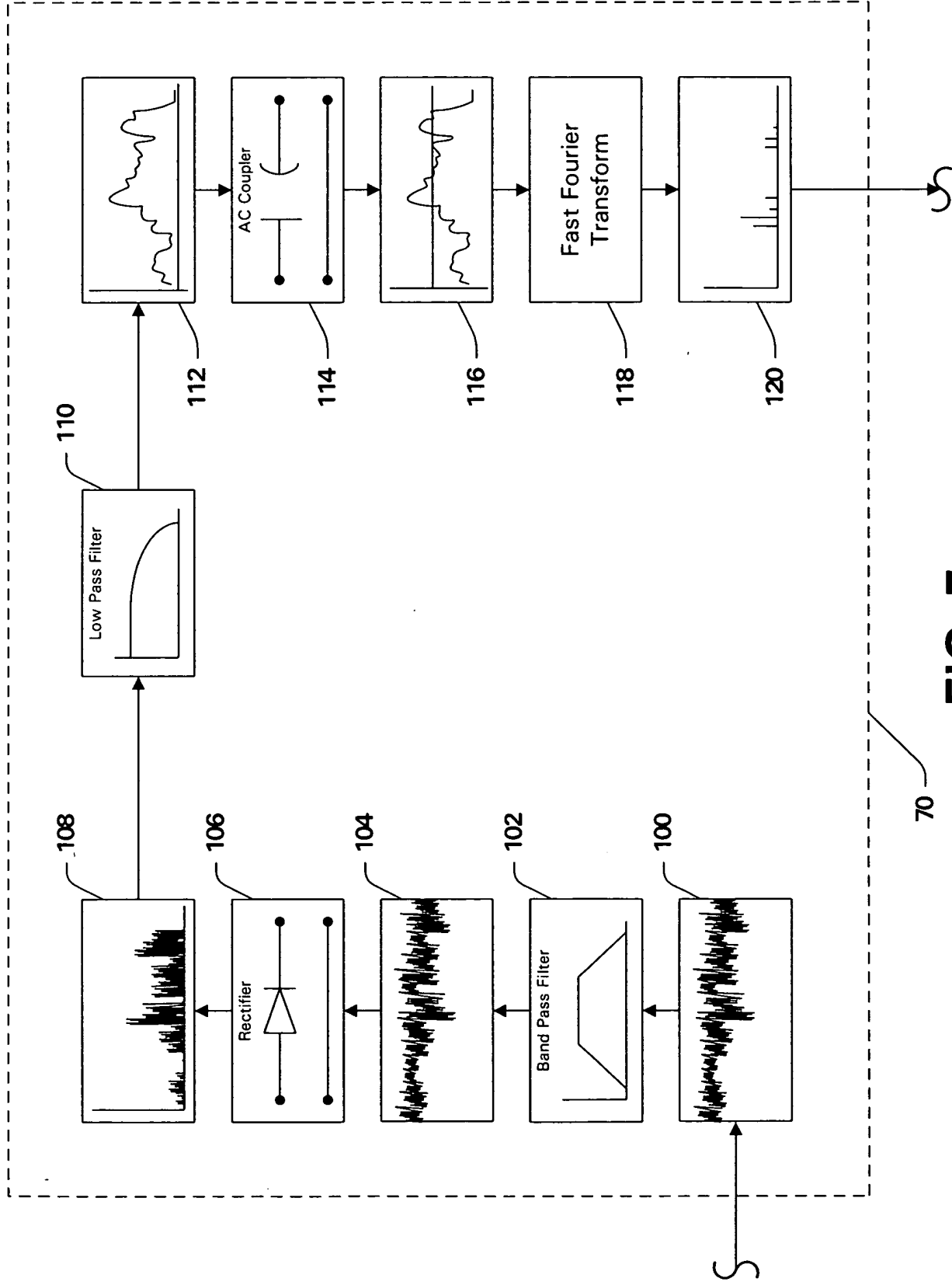


FIG. 7

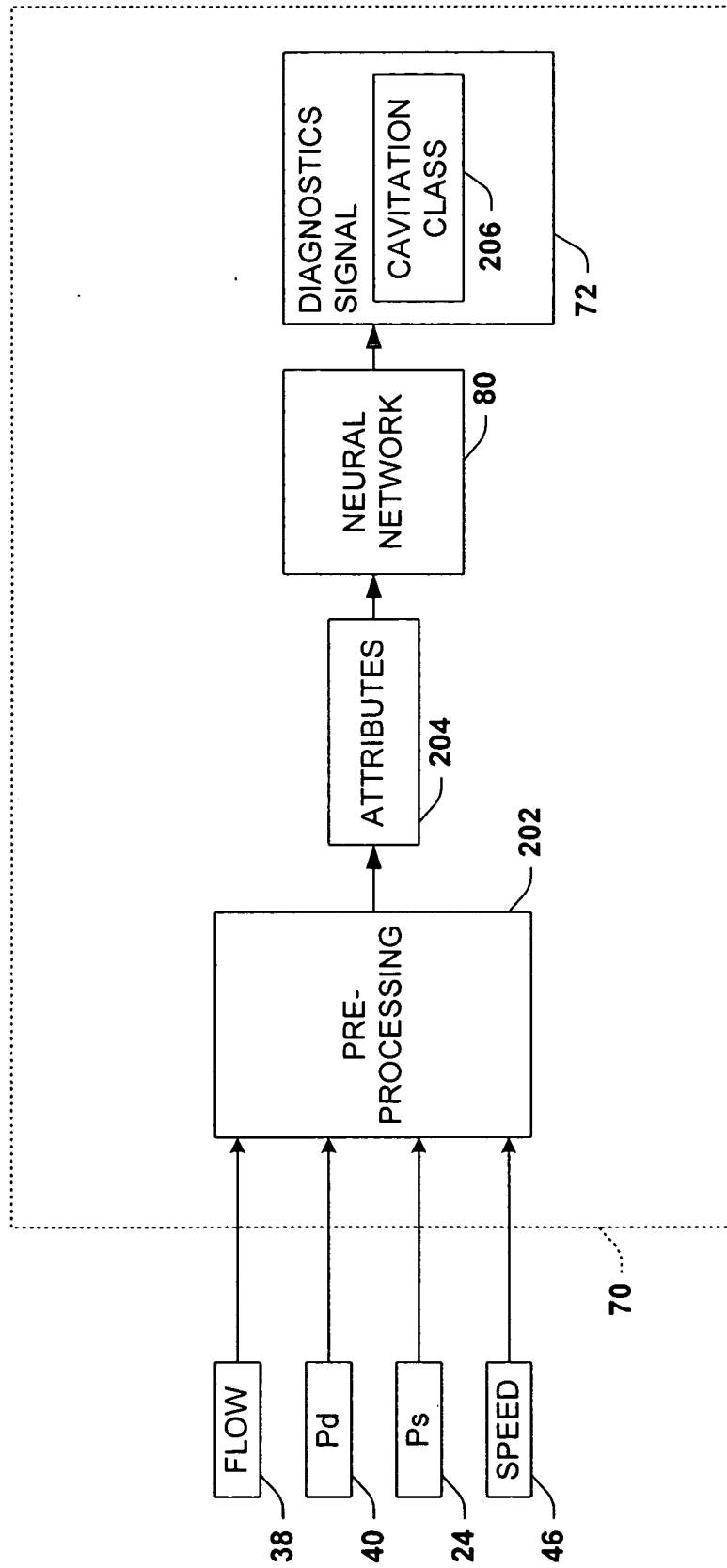


FIG. 8

DIAGNOSTICS SIGNAL	
CLASS 0	normal; no cavitation
CLASS 1	incipient cavitation; mainly balance hole cavitation
CLASS 2	medium cavitation; mainly vane cavitation
CLASS 3	full cavitation; large amount of bubbles on the suction eye but no surging
CLASS 4	surging cavitation; full blown cavitation with surging

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FIG. 9

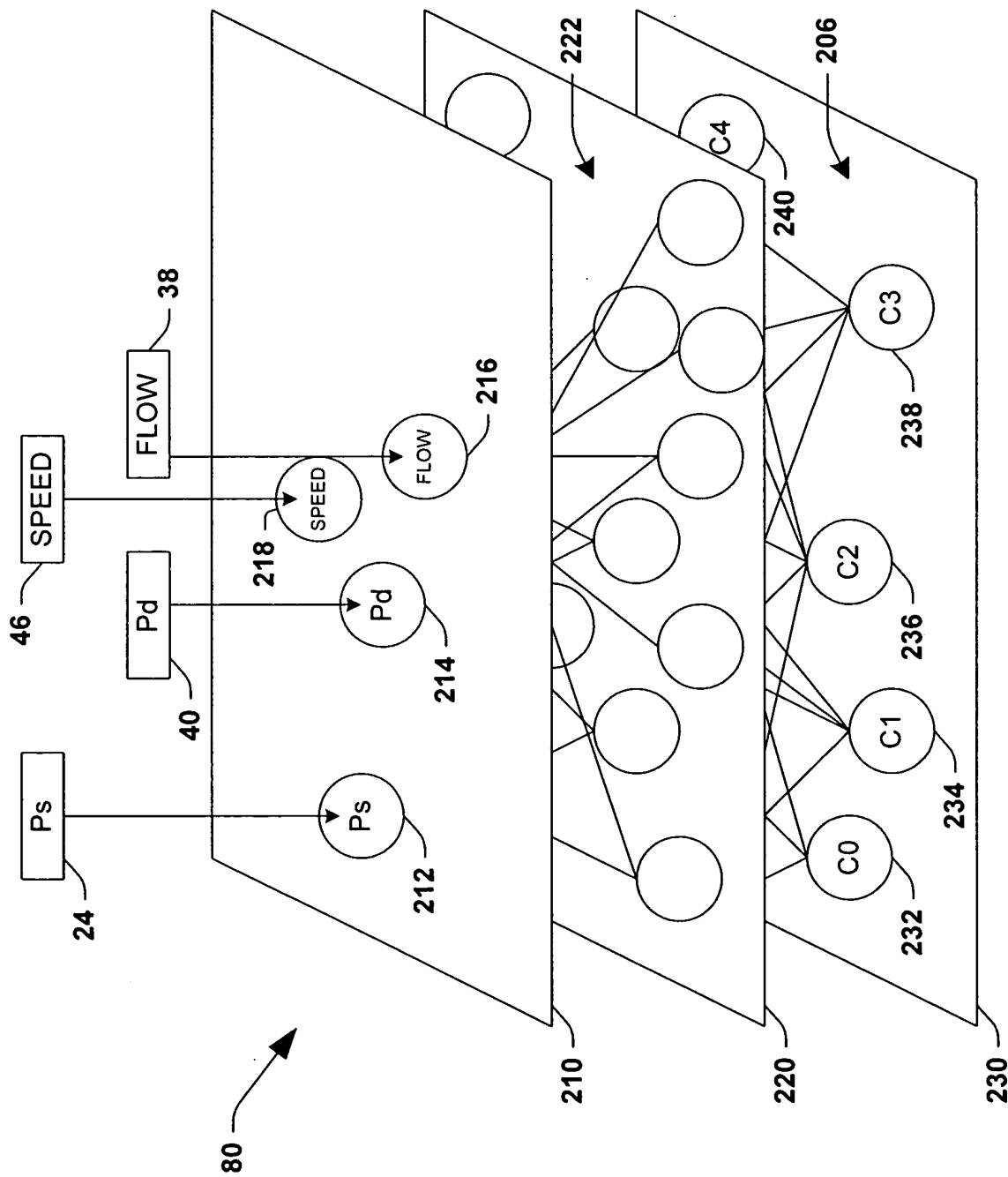


FIG. 10

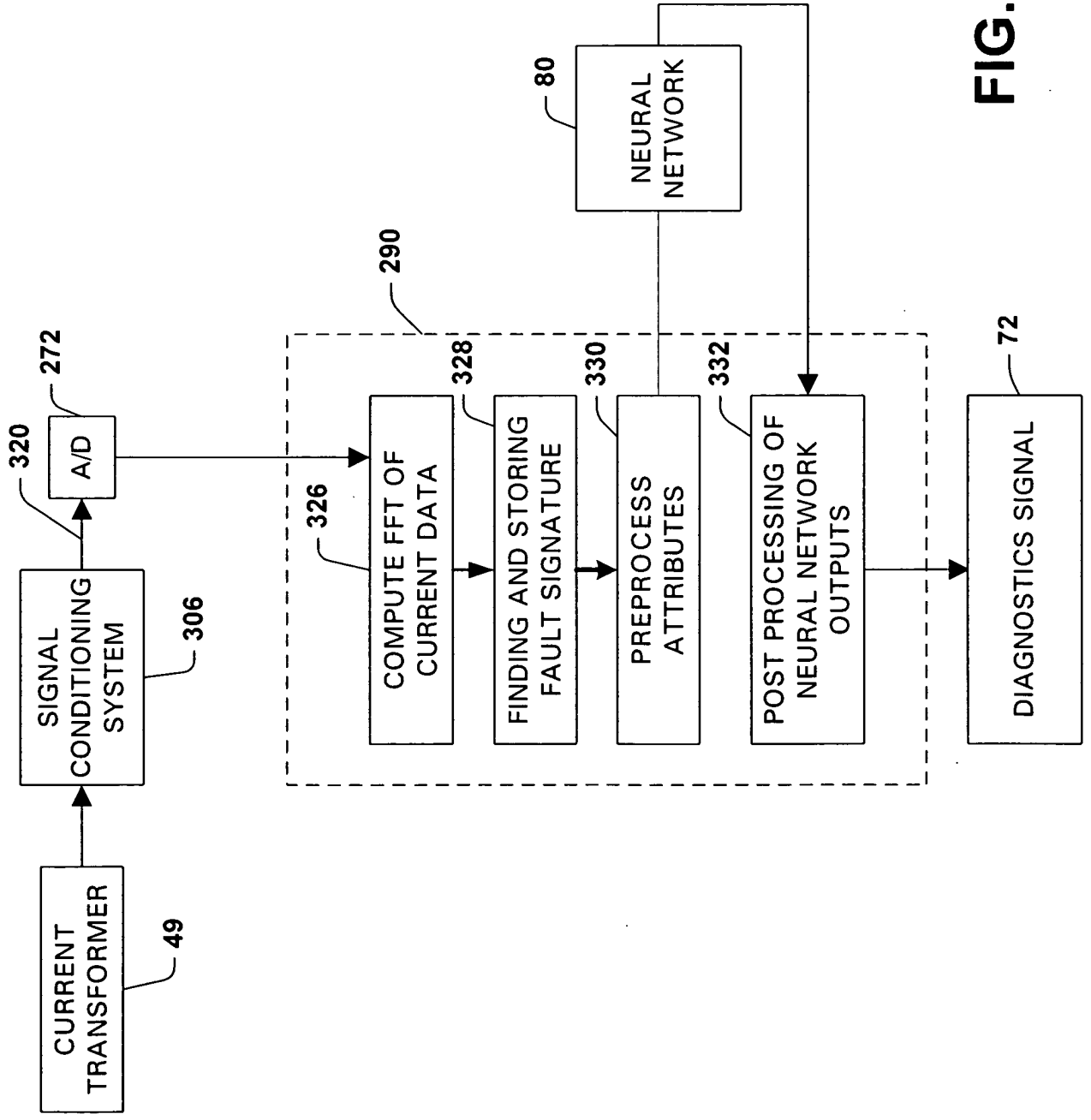


FIG. 11

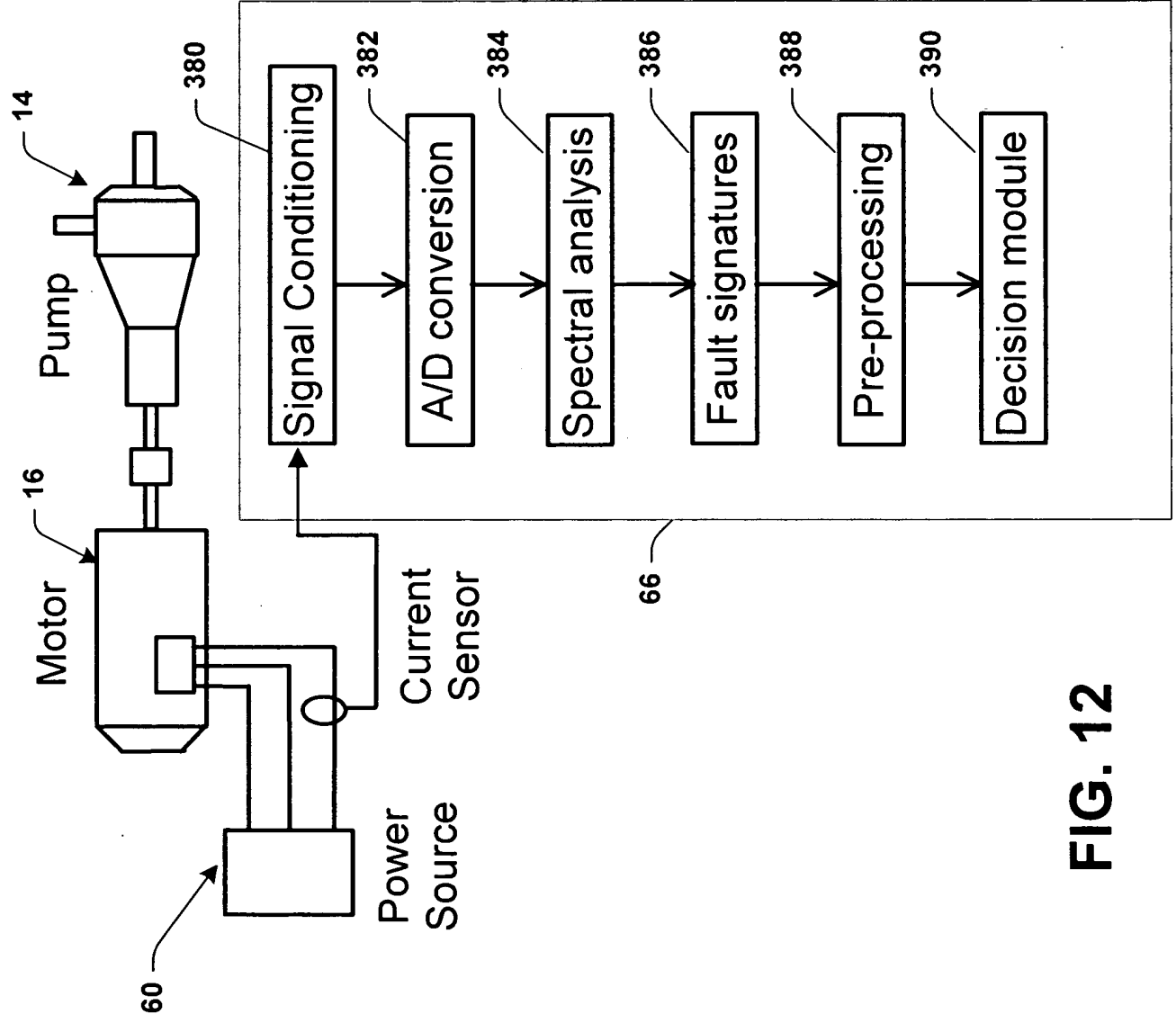


FIG. 12

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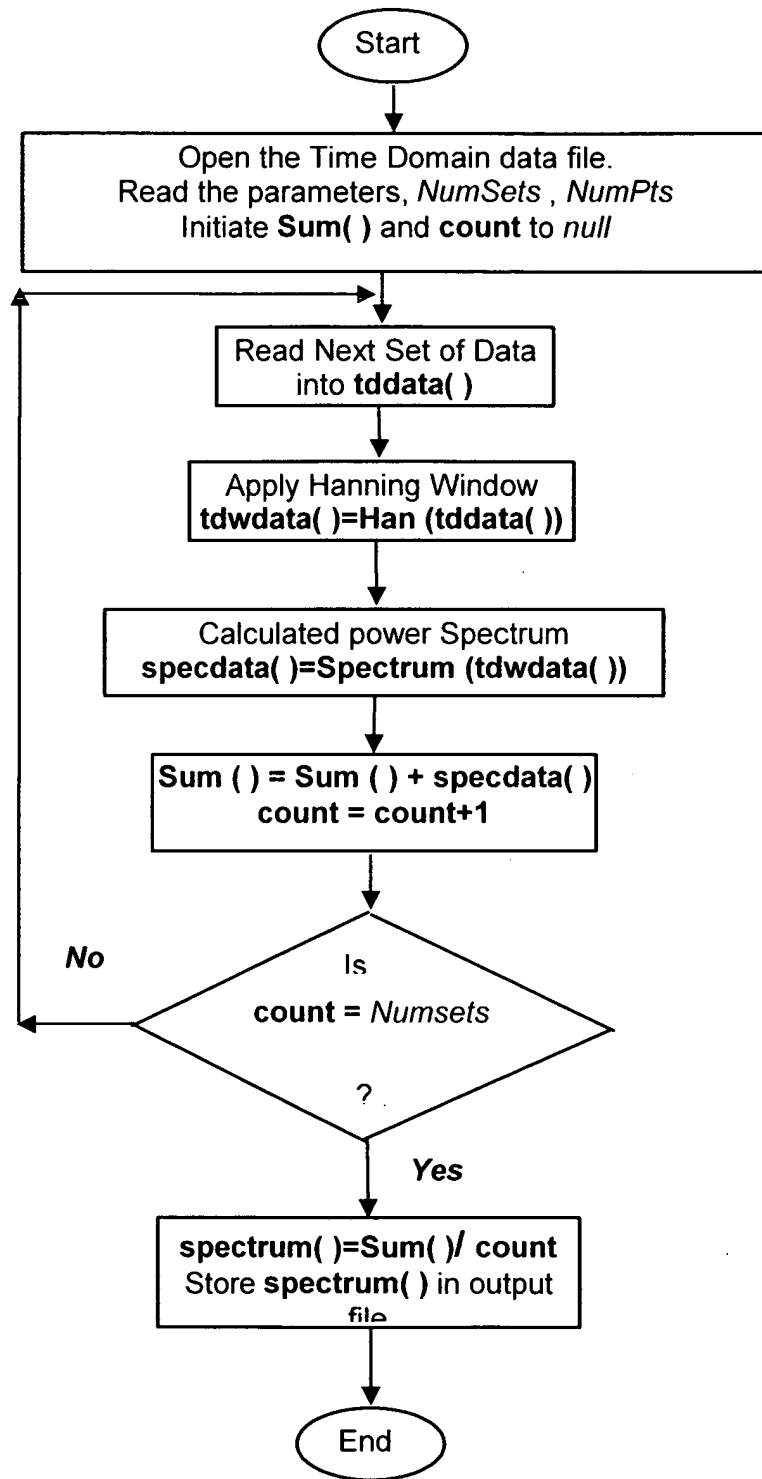


FIG. 13

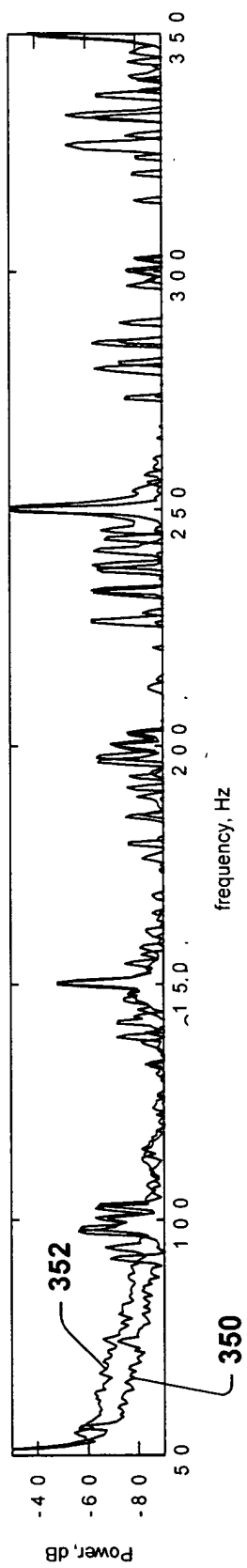


Fig. 14a

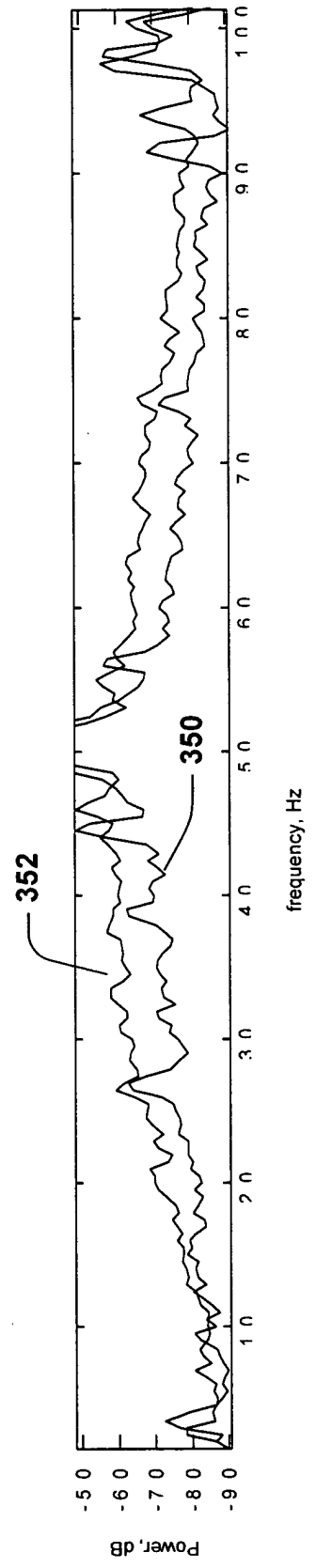


Fig. 14b

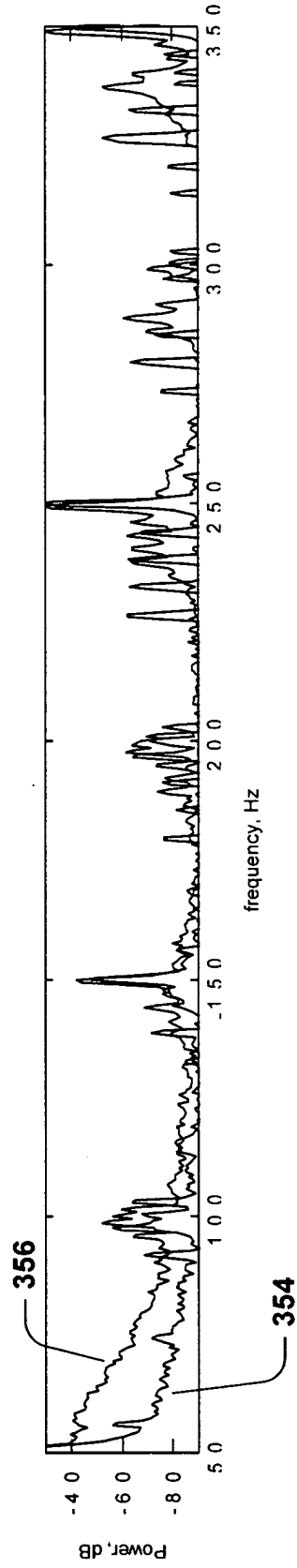


Fig. 14c

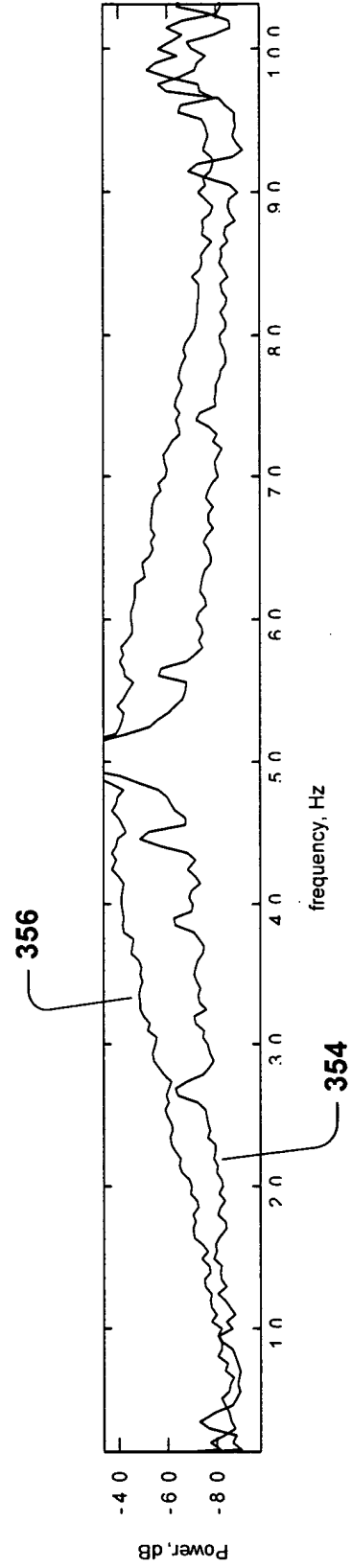


Fig. 14d

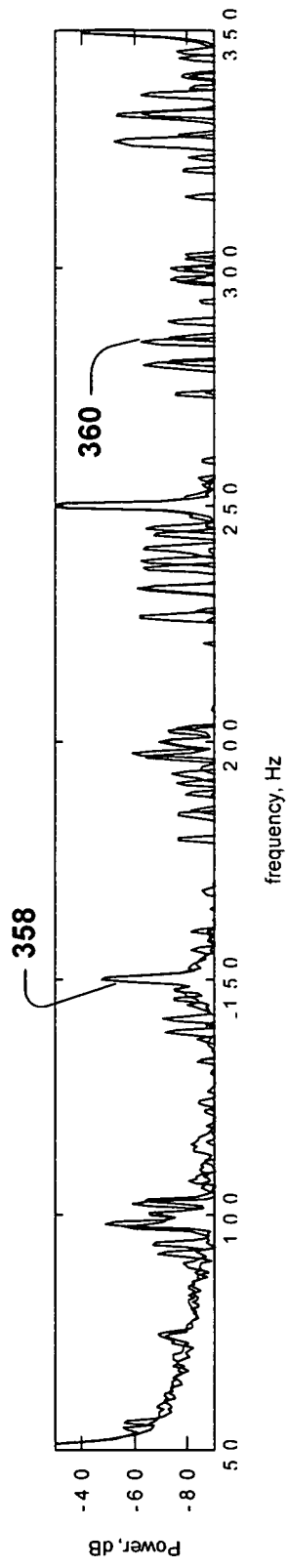


Fig. 14e

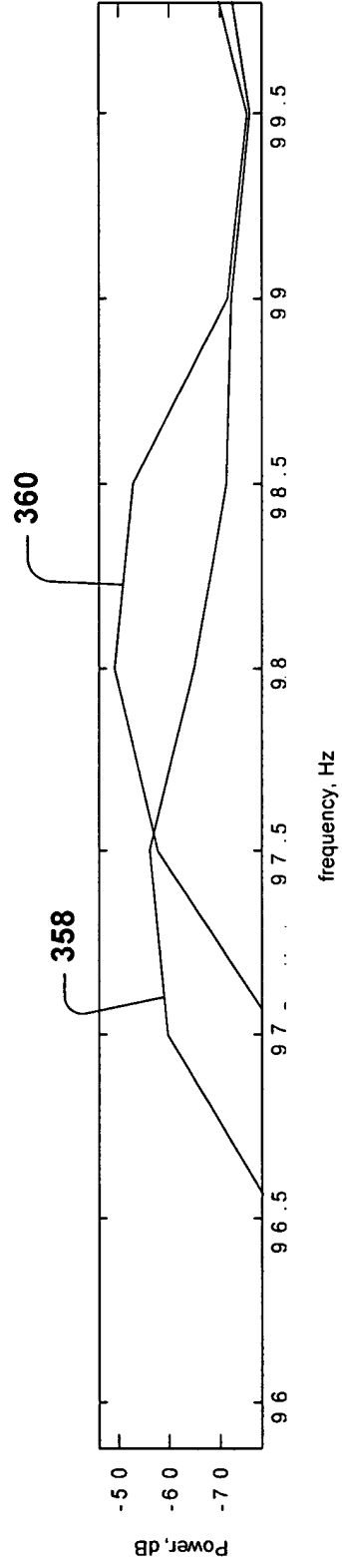


Fig. 14f

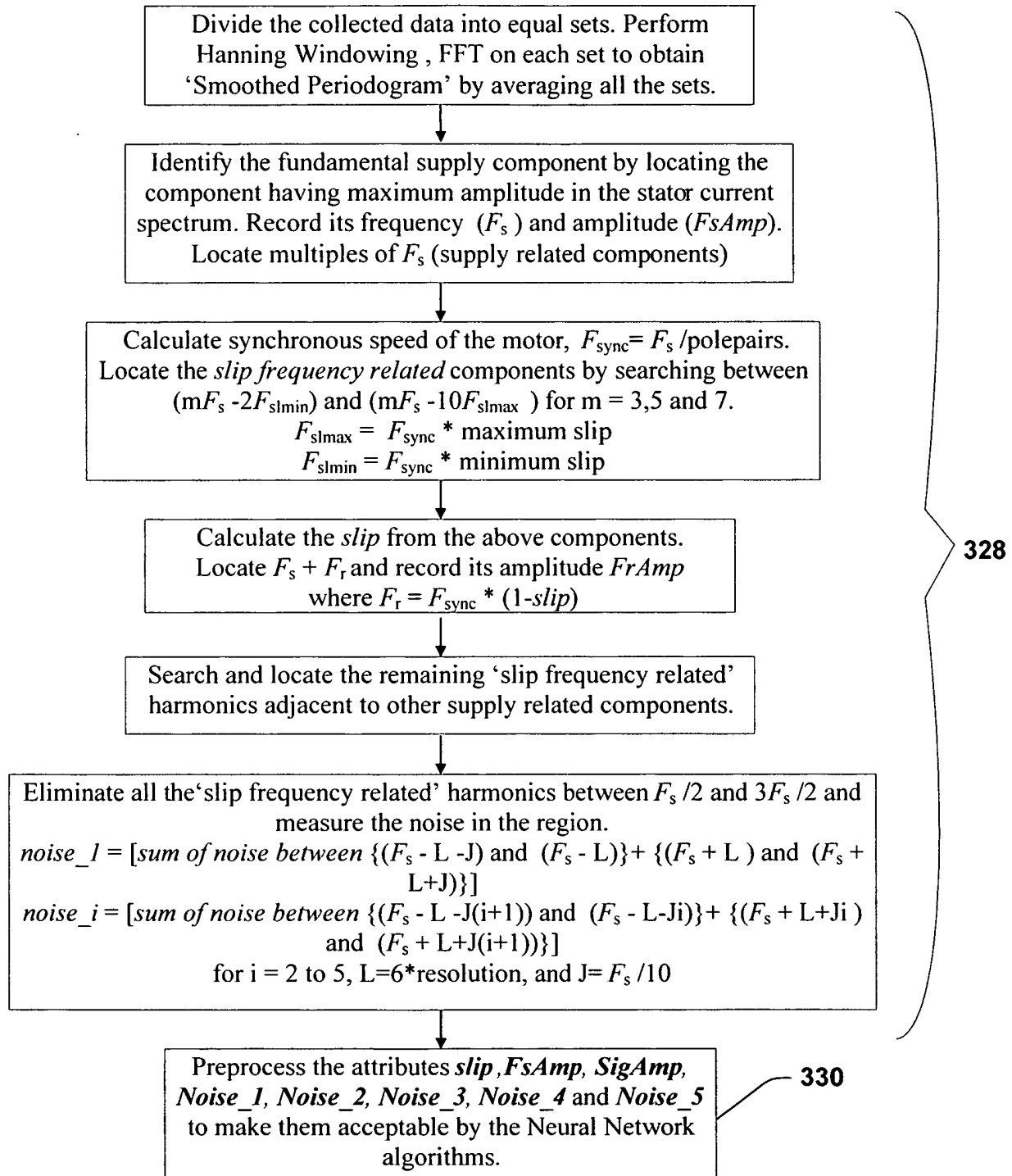


FIG. 15

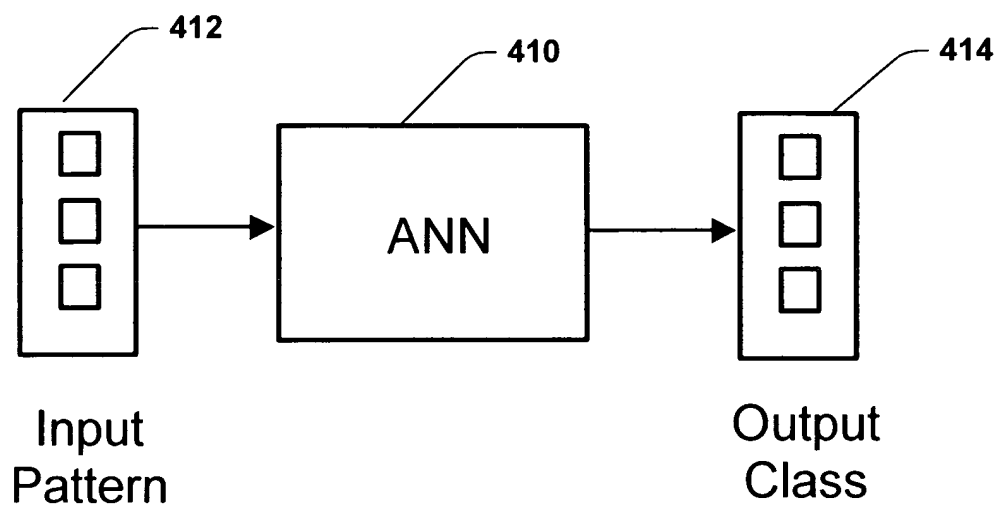


Fig. 16

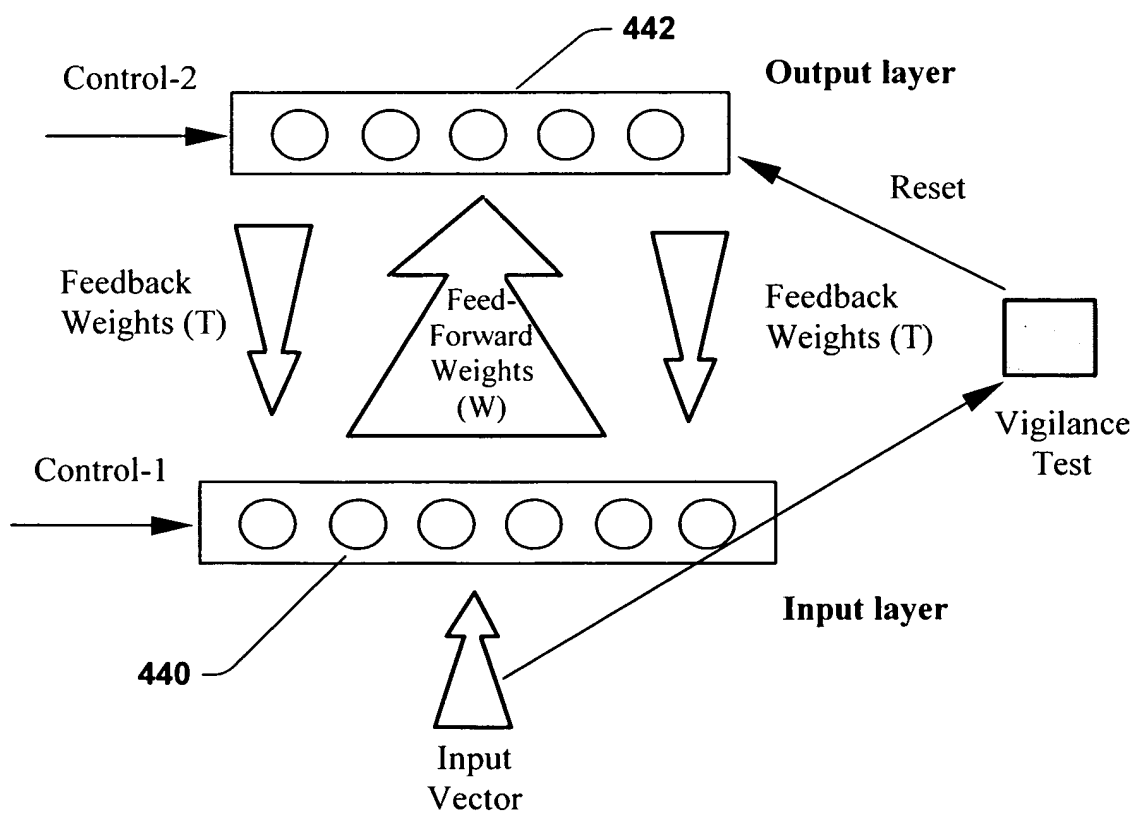


Fig. 17

FIG. 16

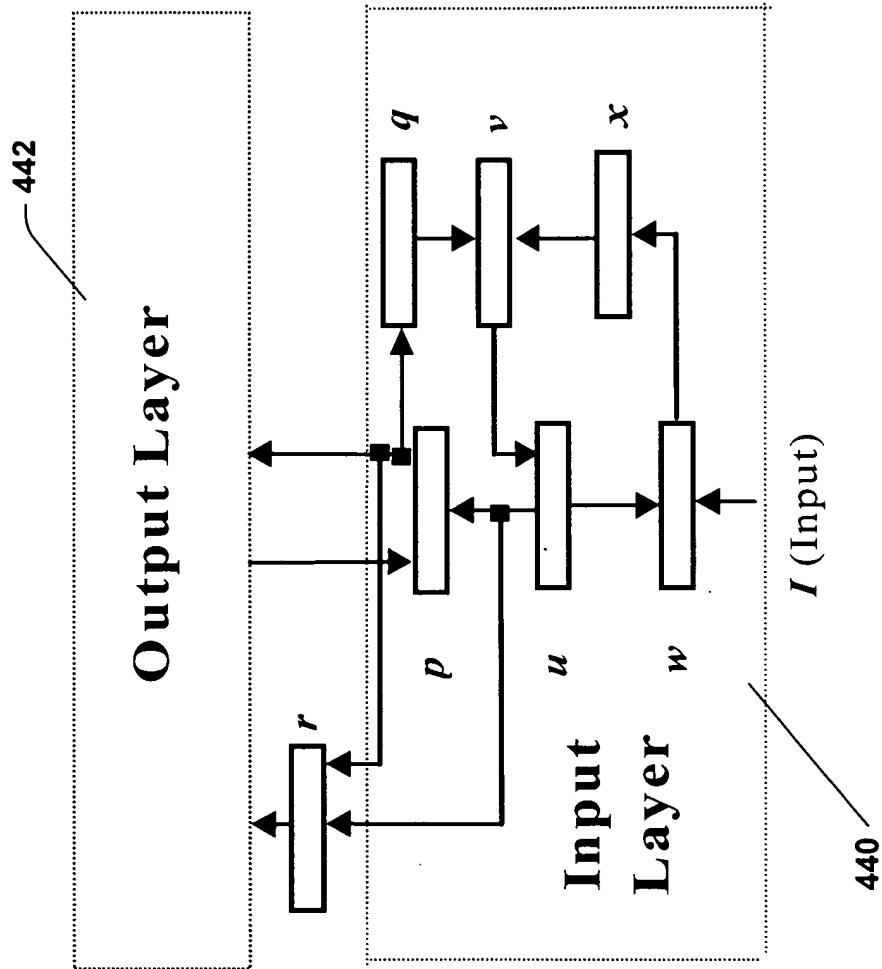


Fig. 18

The diagram illustrates a system for motor fault diagnosis, divided into a physical hardware section and a signal processing flowchart.

Physical Hardware Section:

- Power Source (60):** Provides electrical power to the Motor and the Current Sensor.
- Motor (16):** The primary component being monitored.
- Current Sensor:** Connected to the Motor to monitor its current.
- Pump (14):** Mechanically coupled to the Motor.

Signal Processing Flowchart:

- The signal from the **Current Sensor** is processed through the **Analog front end**.
- The signal then undergoes **A/D conversion**.
- The resulting digital signal is used to calculate the **Frequency Spectrum**.
- From the Frequency Spectrum, a **Fault signature** is extracted.
- The Fault signature is input to the **STAND ALONE DECISION MODULE (470)**.
- Inside the decision module, the signal passes through **Adaptive Preprocessing (472)**.
- The output of Adaptive Preprocessing is fed into the **ALM (474)**.
- The ALM is bidirectionally connected to the **Fuzzy Expert System (FRBES) (476)**.
- The final output of the decision module is the **Condition of the Plant**.

Fig. 19

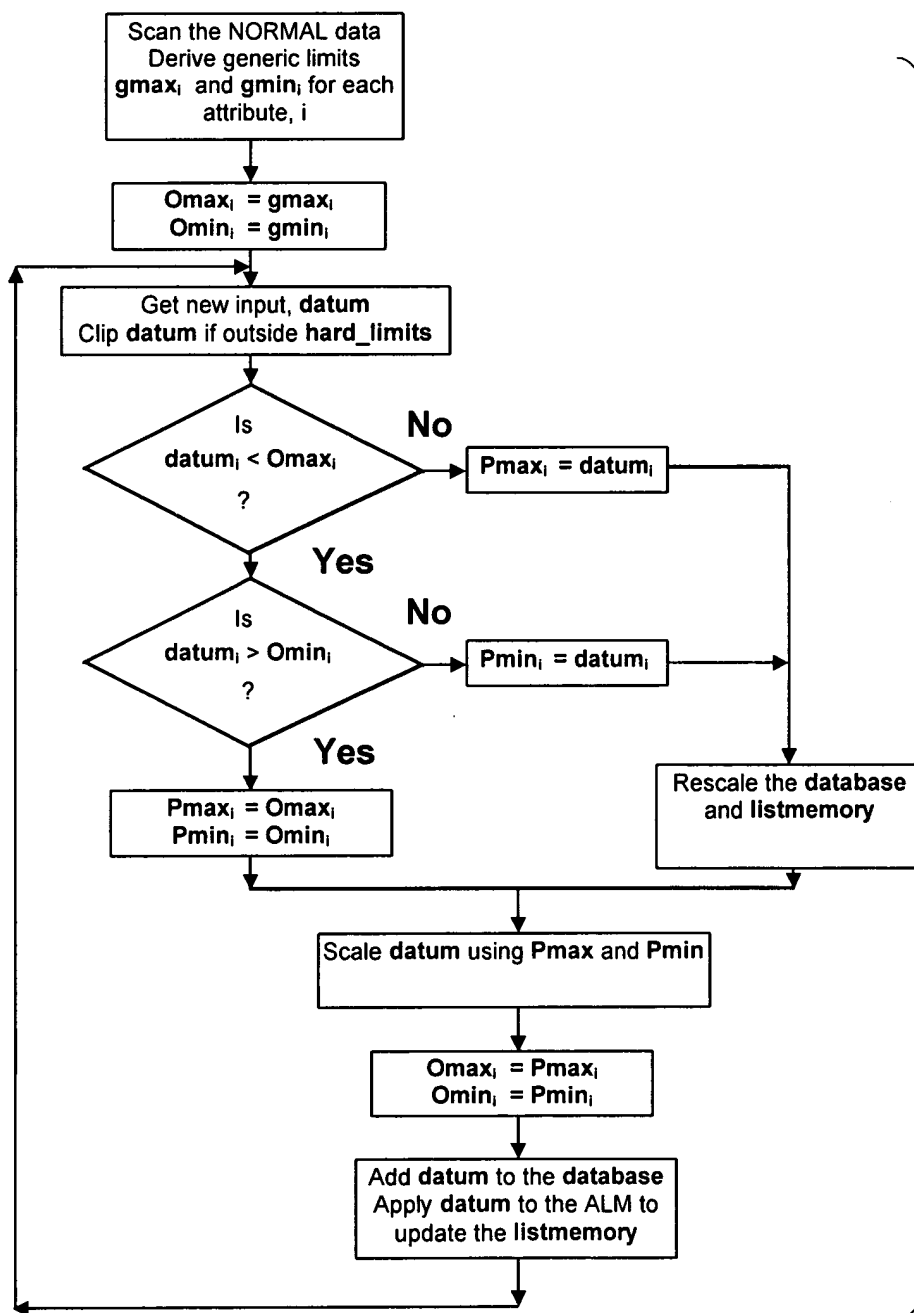


Fig. 20

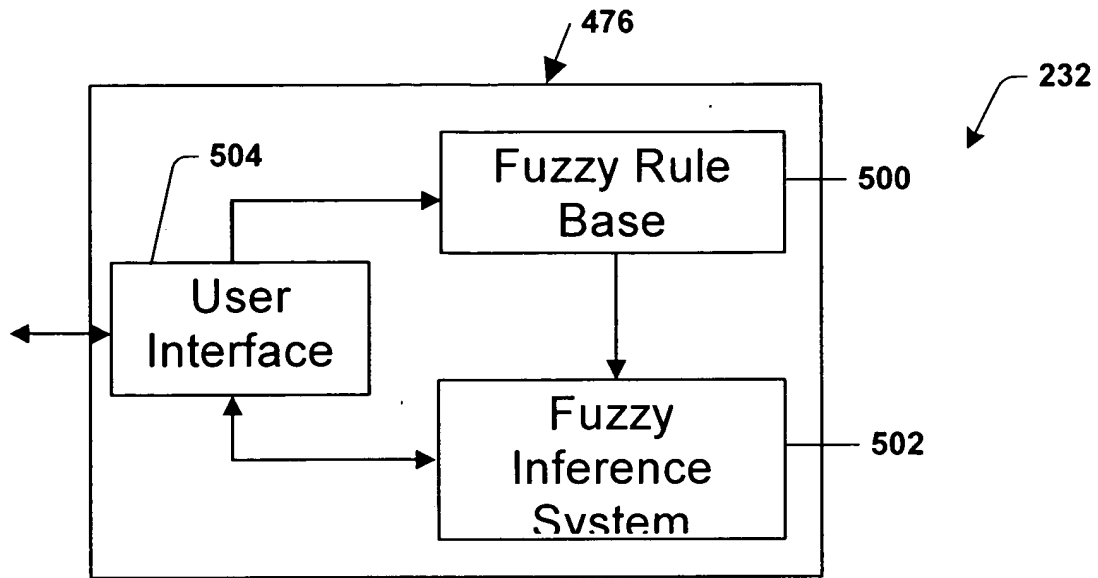


Fig. 21

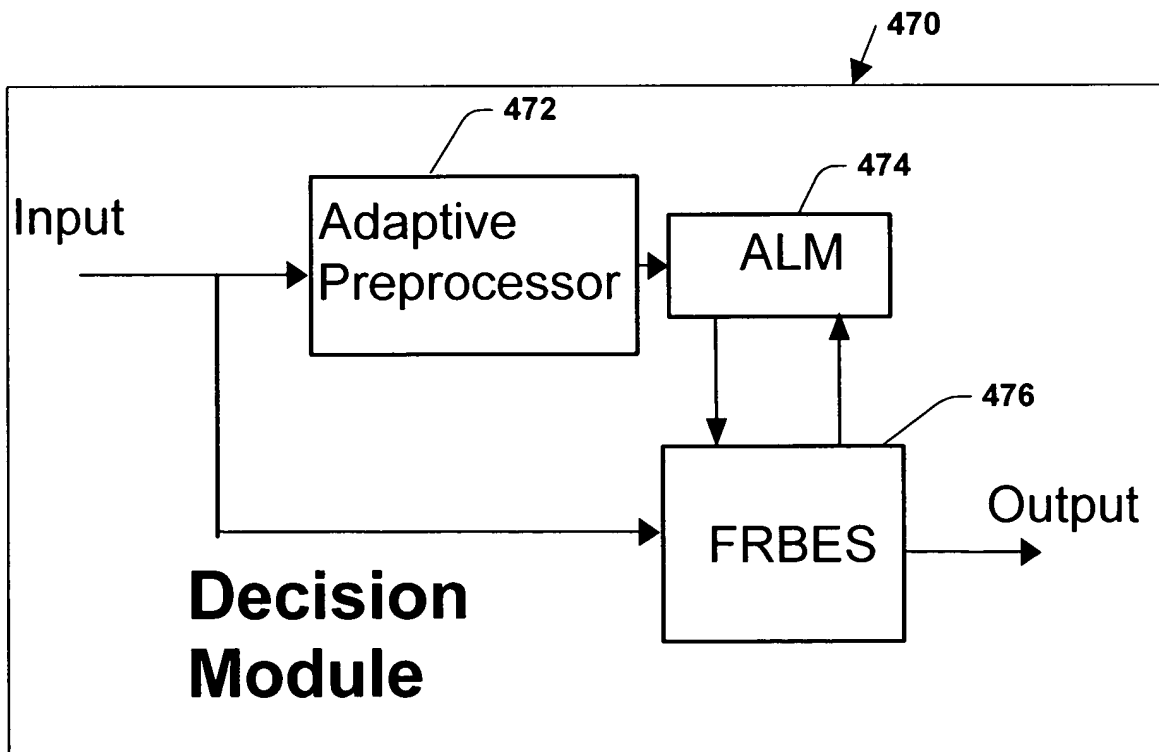


Fig. 22


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IF all the attributes are NORMAL THEN condition is normal
IF slip is SLLO and noise_2 is HI THEN condition is low-cav
IF noise_4 and noise_5 are VERHI THEN condition is sev-cav
    IF noise_4 and noise_5 are HI THEN condition is sev-cav
IF FsAmp is SLLO and noise_5 are SLHI THEN condition is sev-cav
    IF FsAmp is LO and noise_5 is SLHI THEN condition is sev-cav
IF FsAmp is VERLO and noise_5 is SLHI THEN condition is sev-cav
    IF FsAmp is SLLO and noise_4 are HI THEN condition is sev-cav
        IF FsAmp is LO and noise_4 is HI THEN condition is sev-cav
        IF FsAmp is LO and noise_4 is VERHI THEN condition is sev-cav
IF FsAmp is SLLO and slip is SLLO and noise_4 is NORMAL and noise_5 is NORMAL THEN condition is low-
block
IF FsAmp is LO and noise_4 is NORMAL and noise_5 is NORMAL THEN condition is sev-block
    IF slip and FsAmp are VERLO THEN condition is sev-block
        IF FrAmp is HI THEN condition is impel-fault
        IF framp is VERHI THEN condition is impel-fault

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Fig. 23

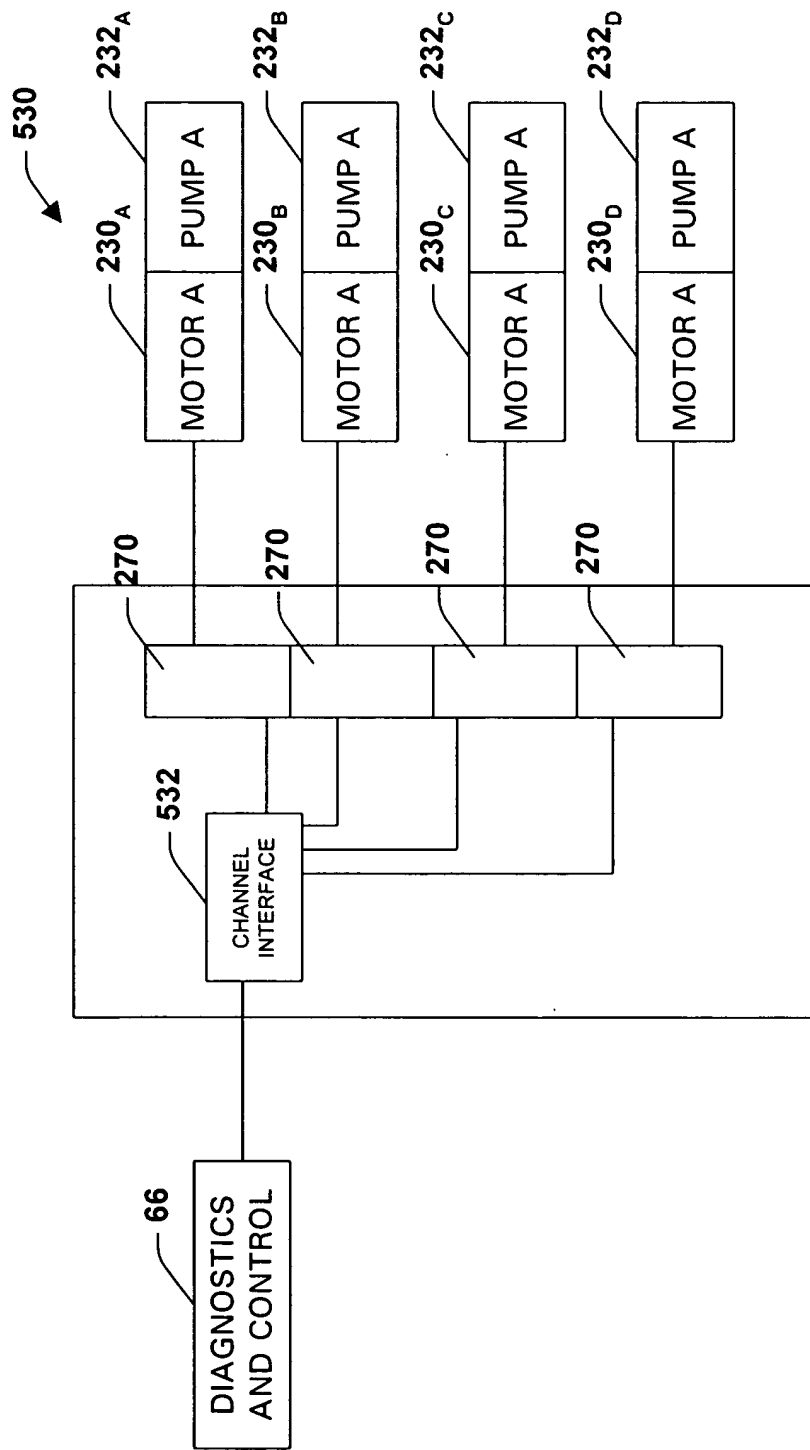


Fig. 24

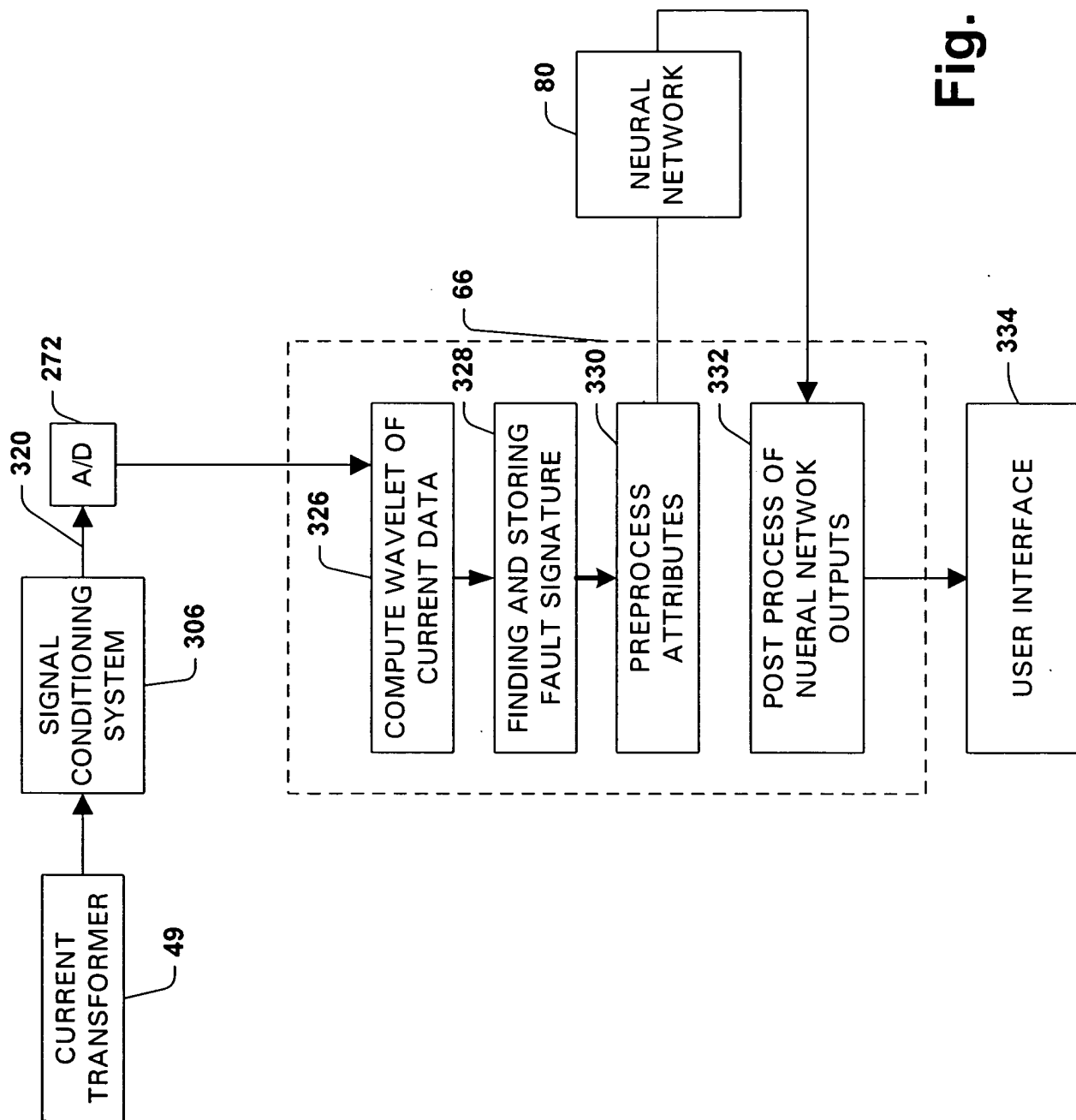


Fig. 25

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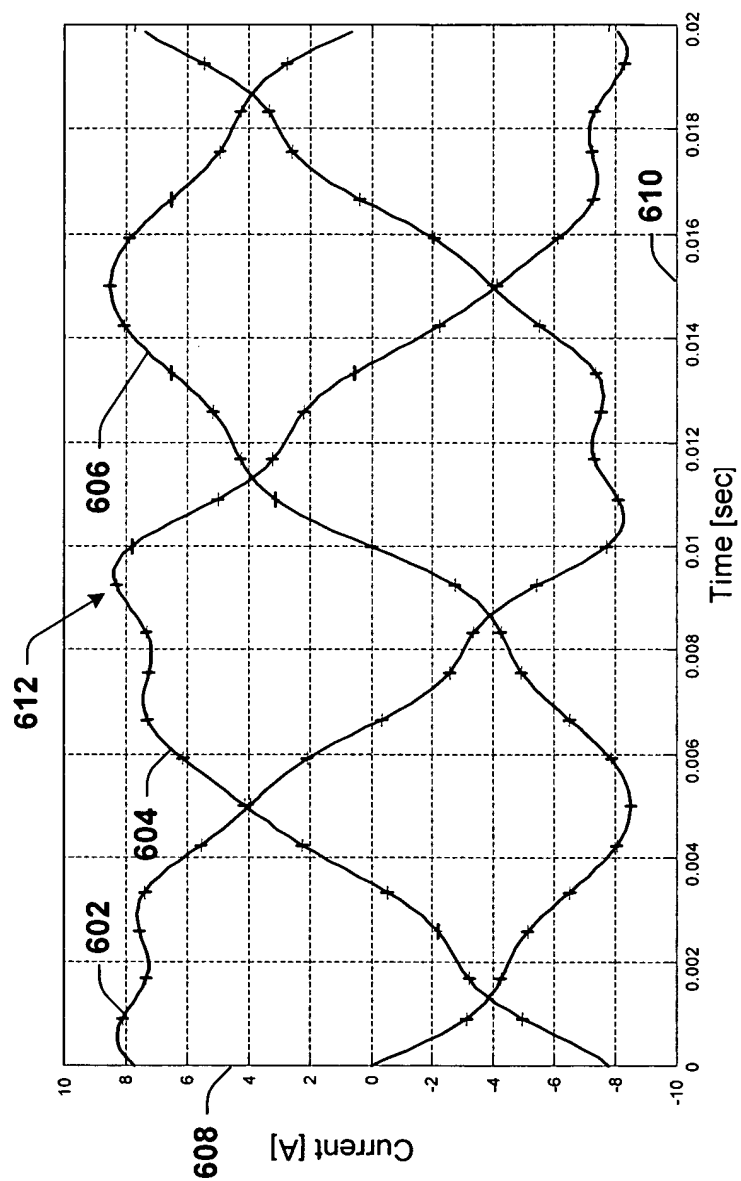


FIG. 26

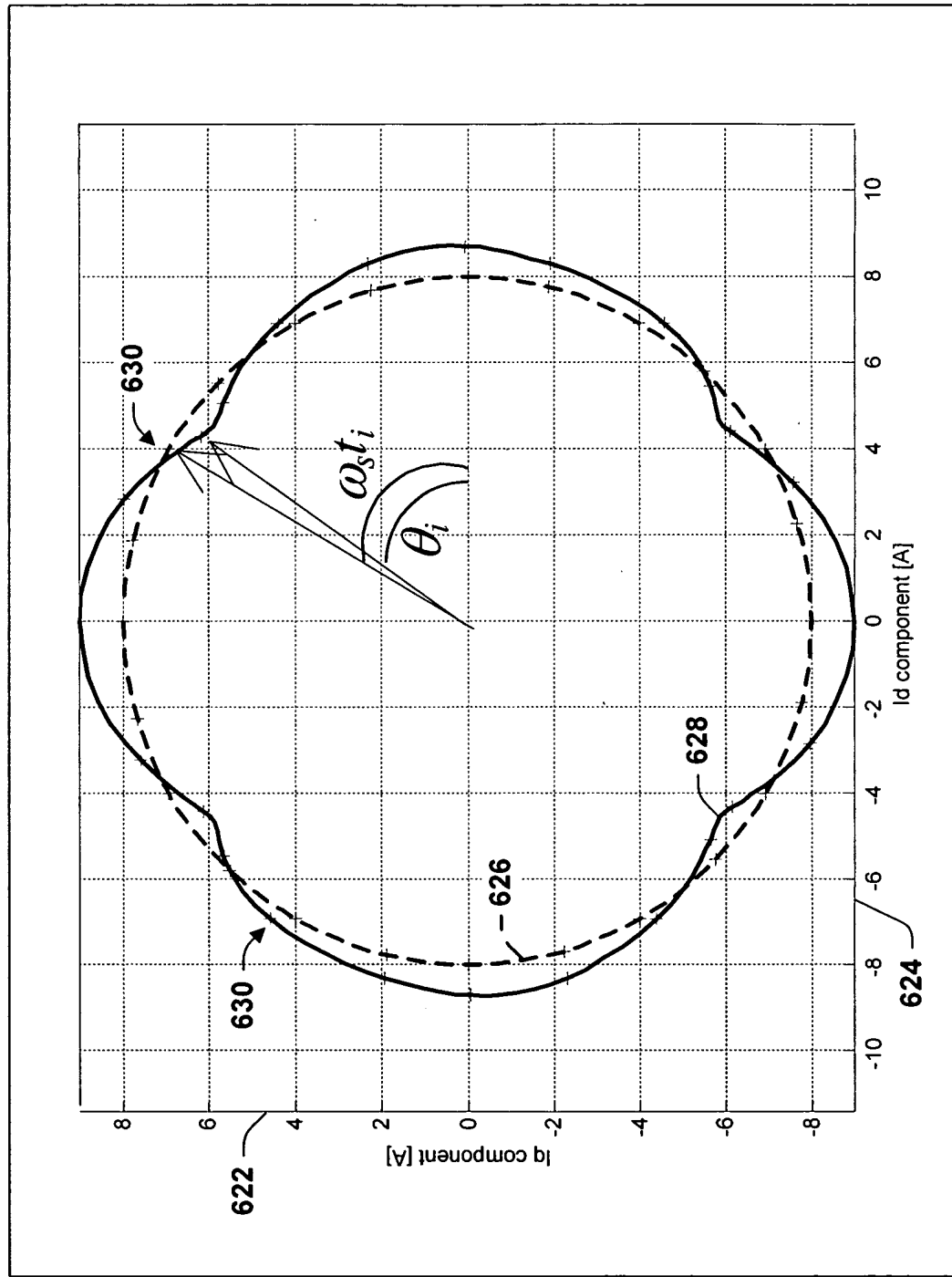


FIG. 27

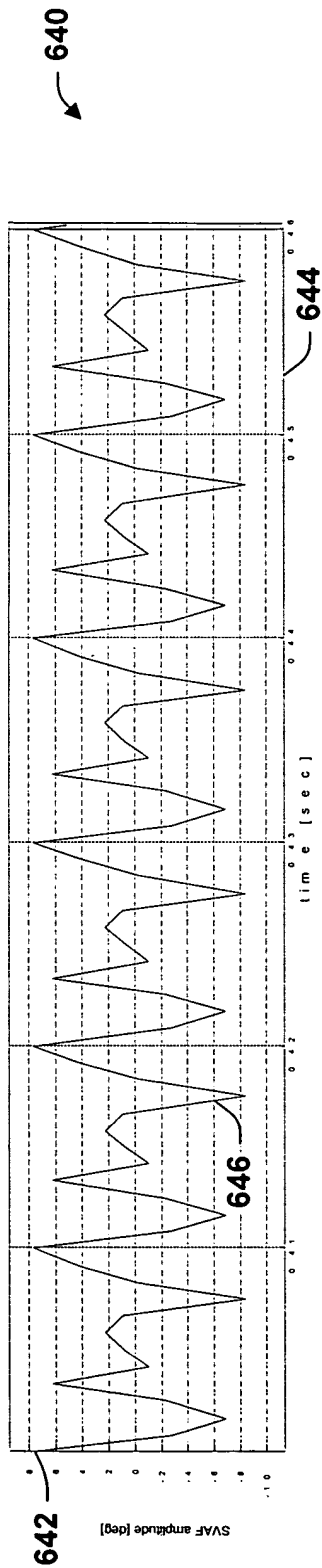


FIG. 28

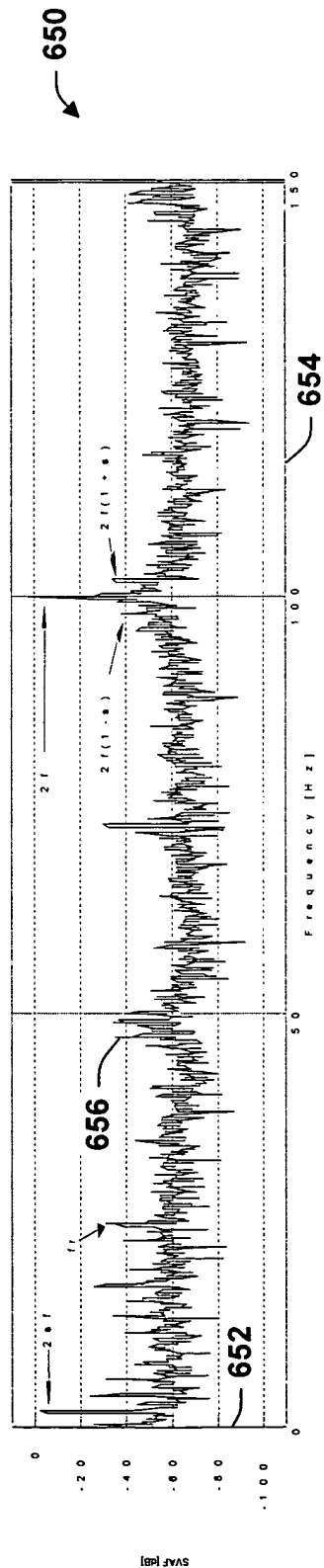


FIG. 29

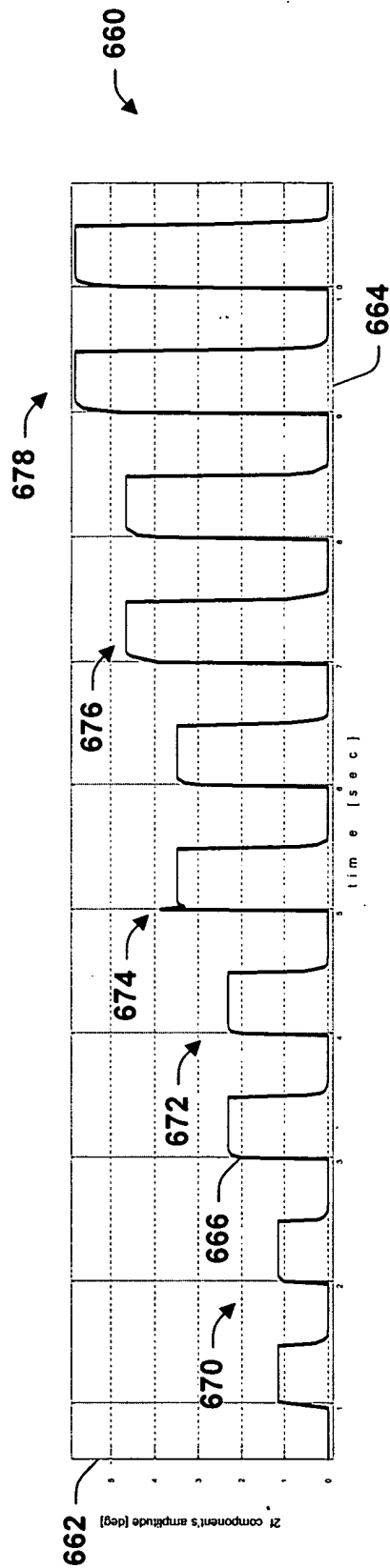


FIG. 30

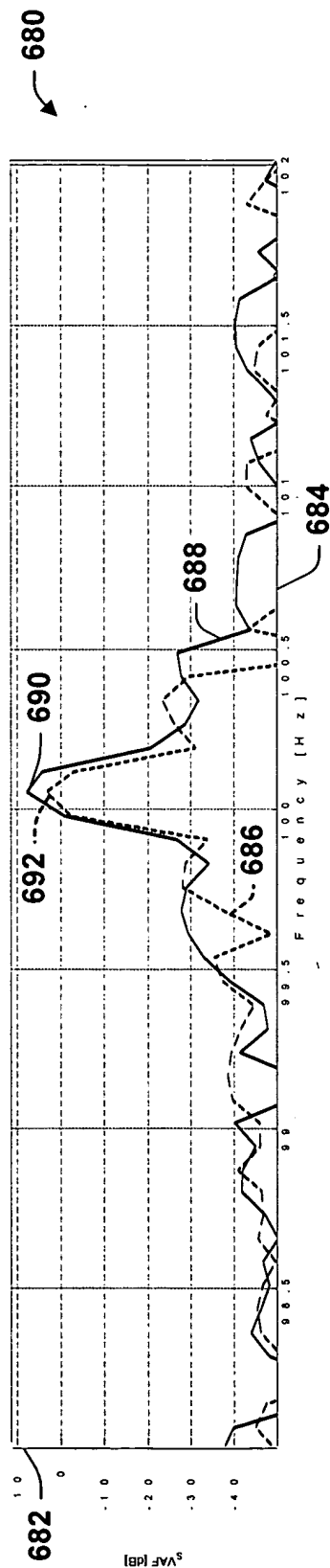


FIG. 31

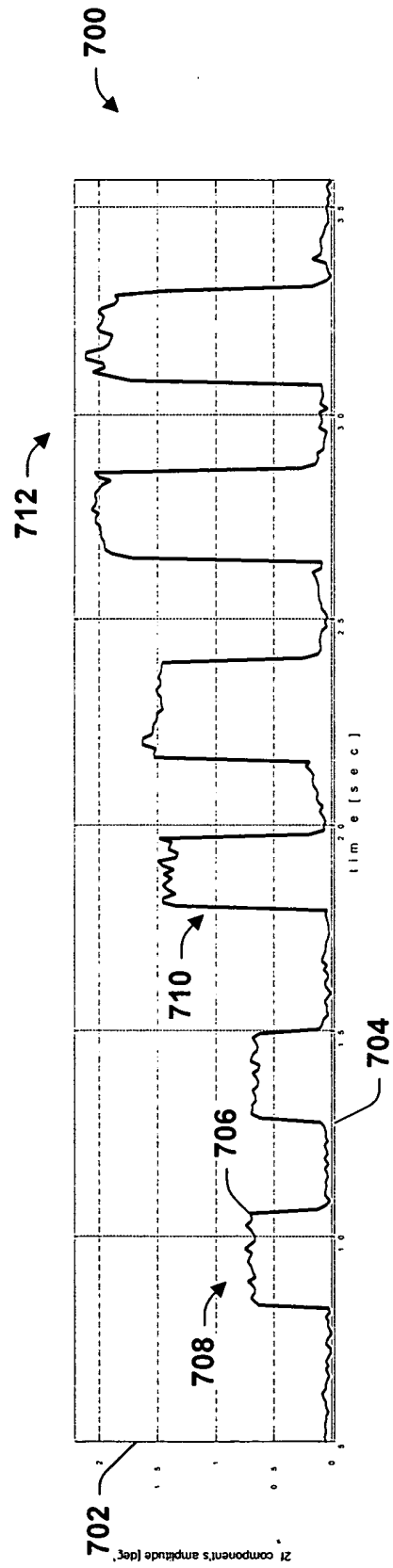


FIG. 32

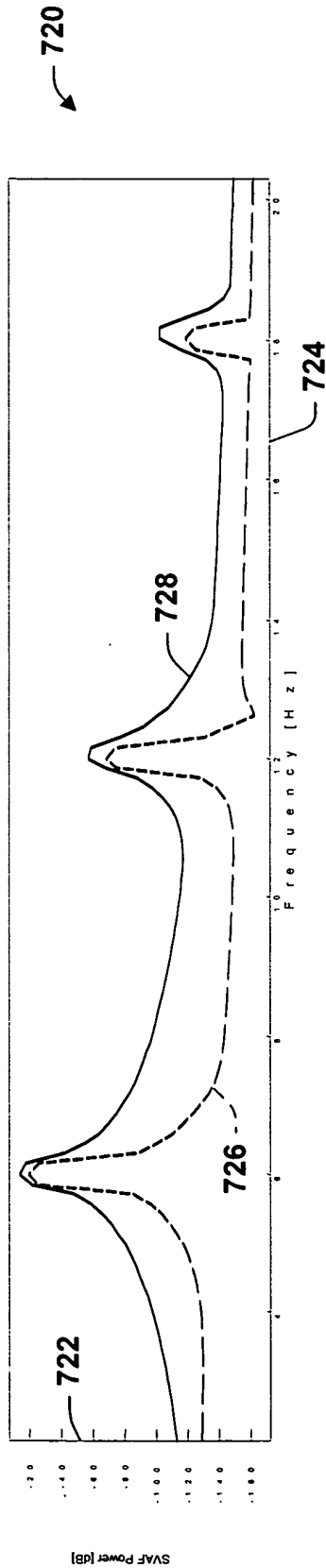


FIG. 33

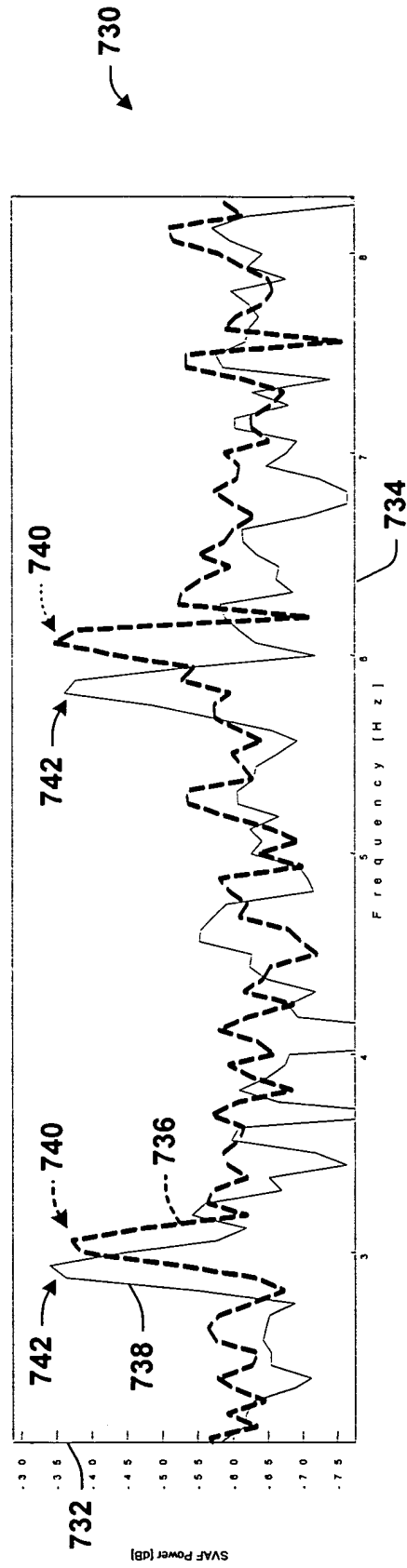


FIG. 34

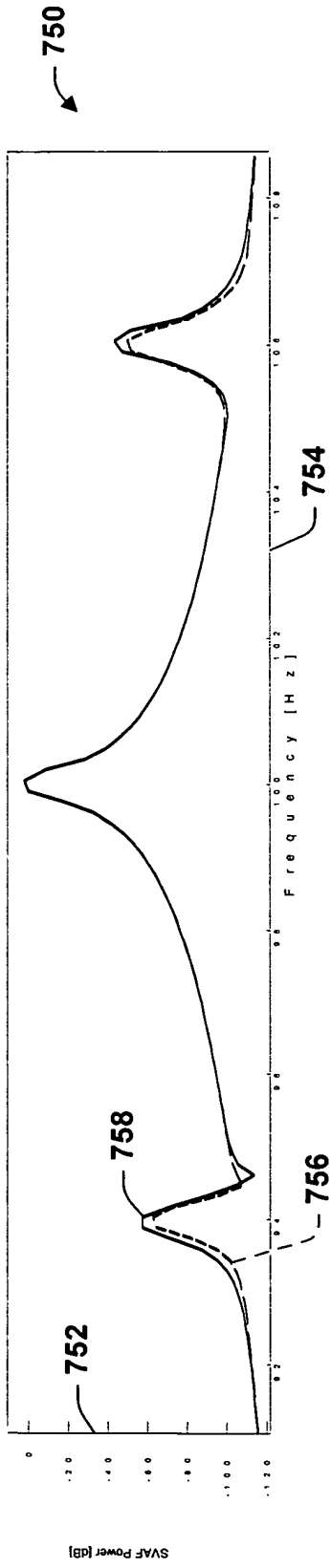


FIG. 35

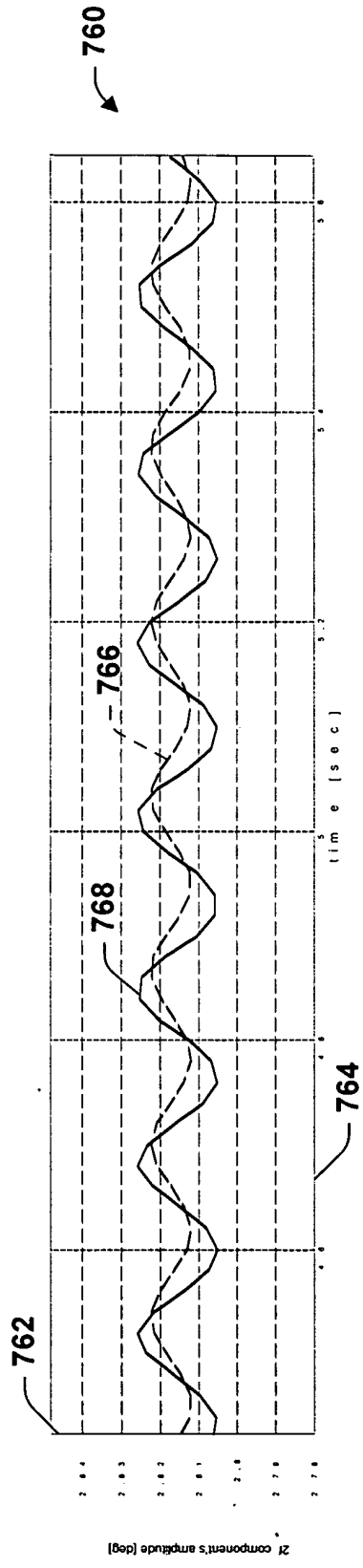


FIG. 36

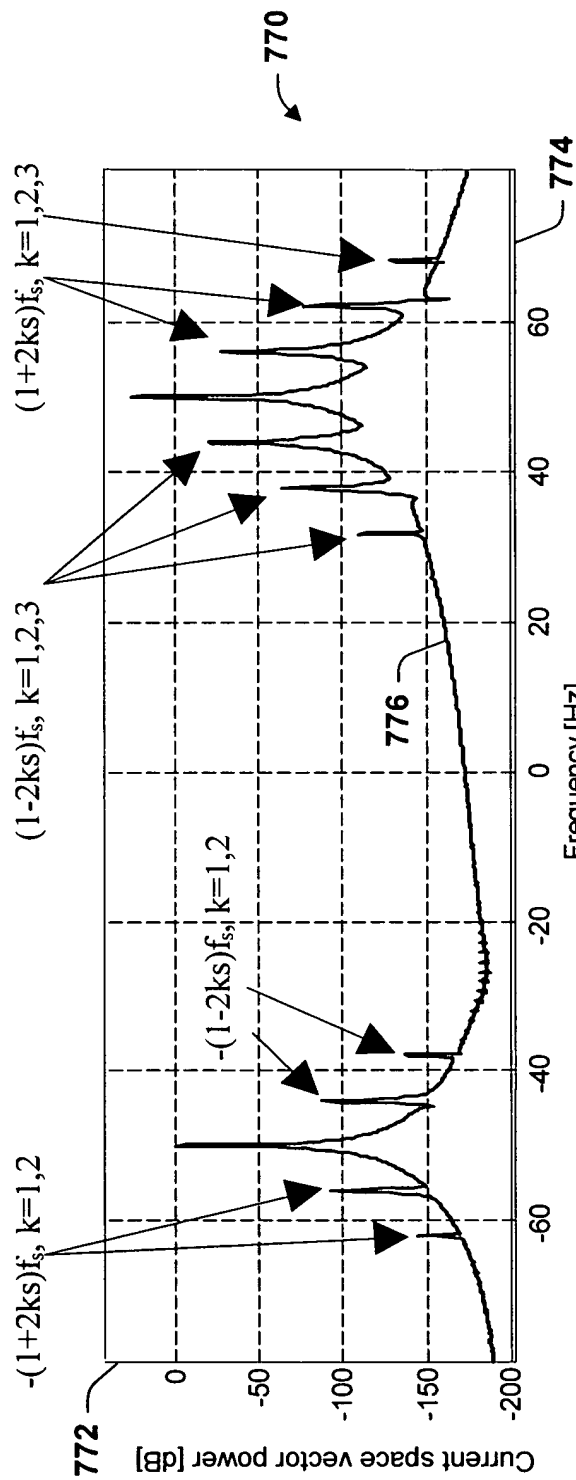


FIG. 37

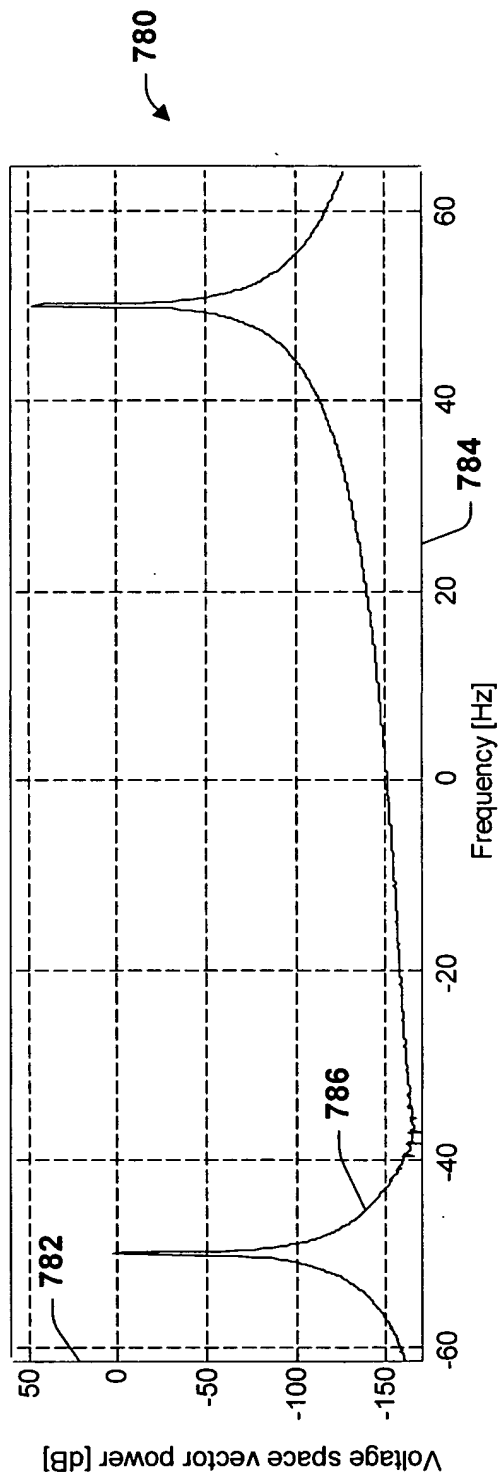


FIG. 38

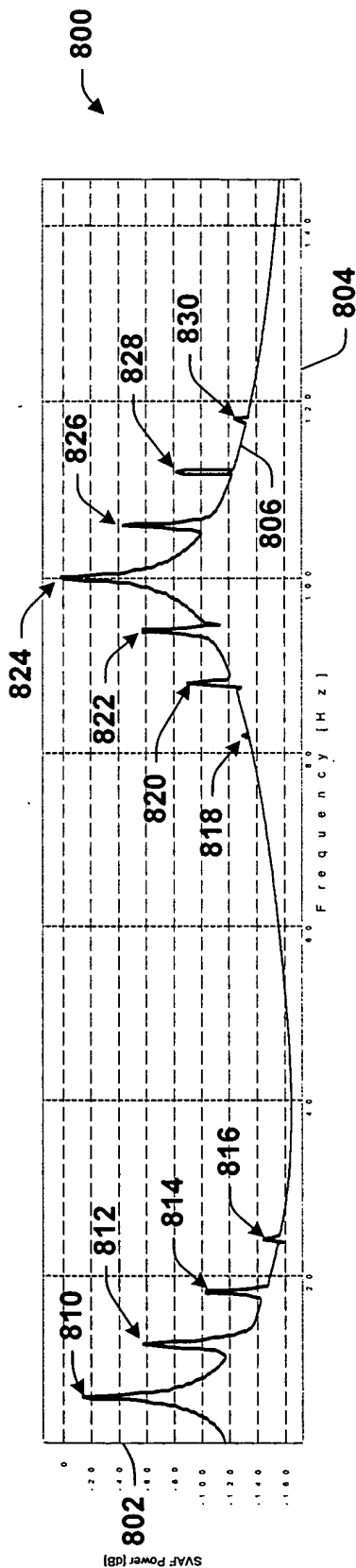


FIG. 39

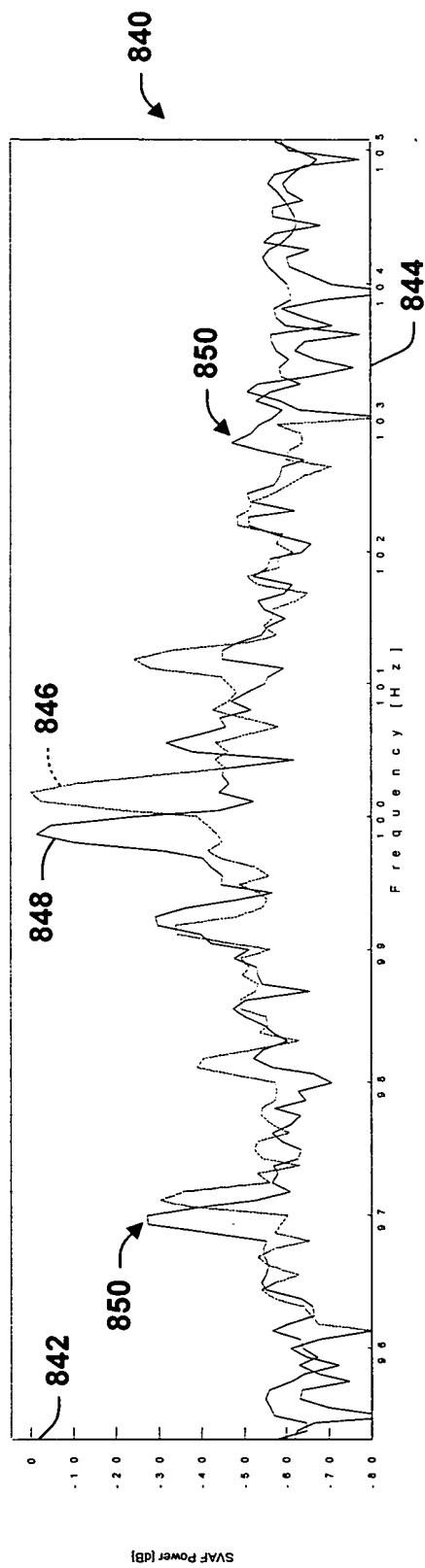


FIG. 40

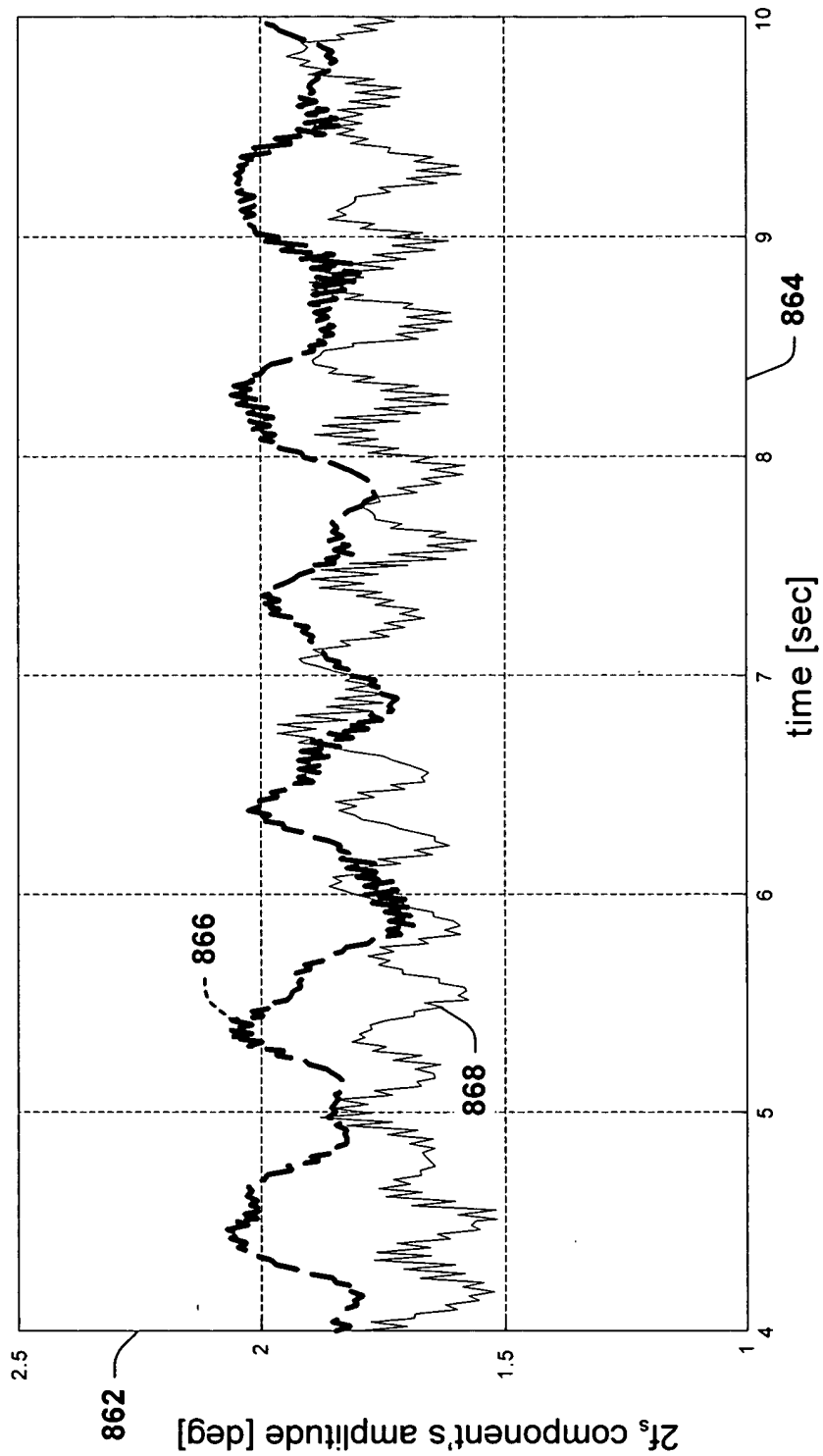


FIG. 41

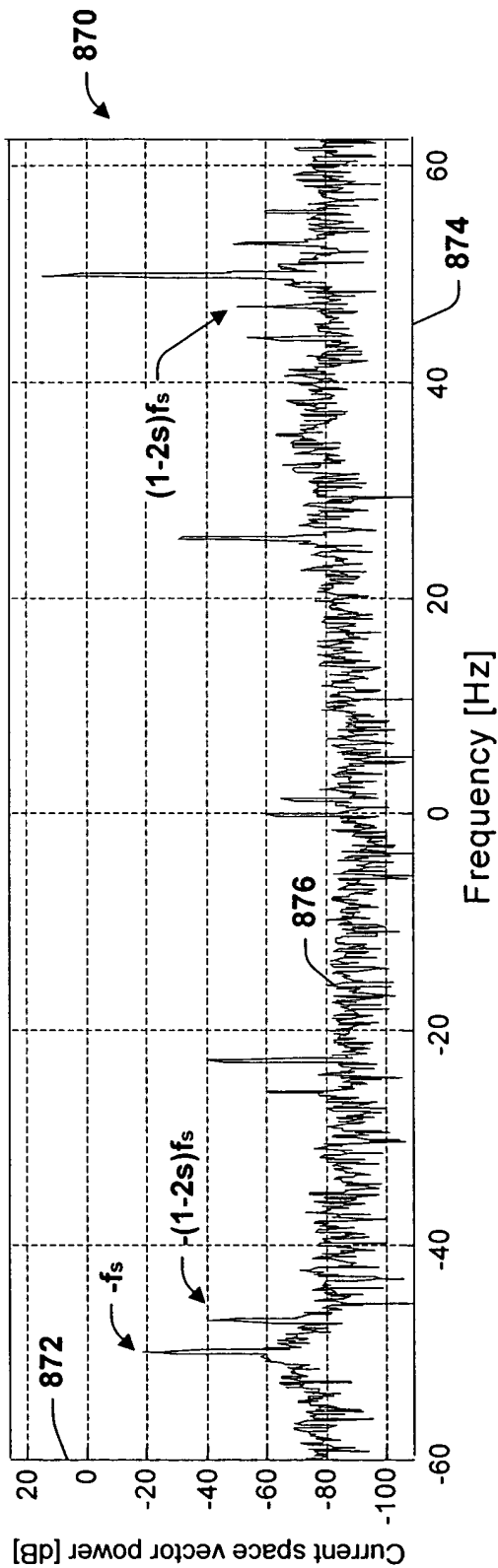


FIG. 42

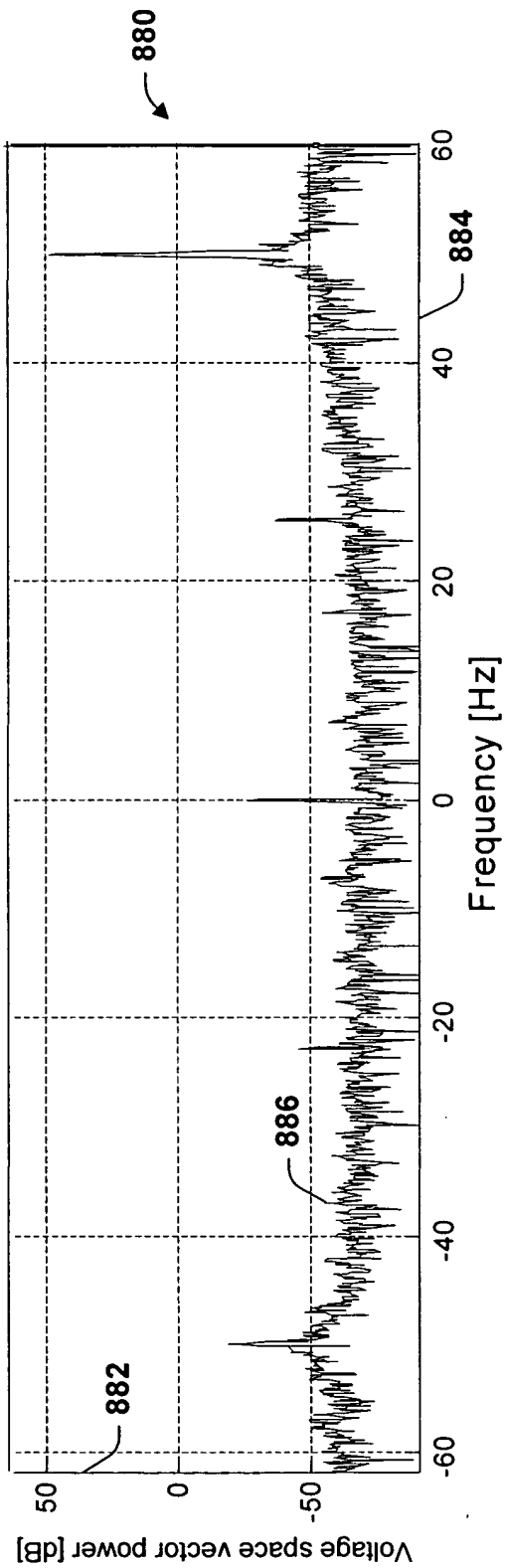


FIG. 43

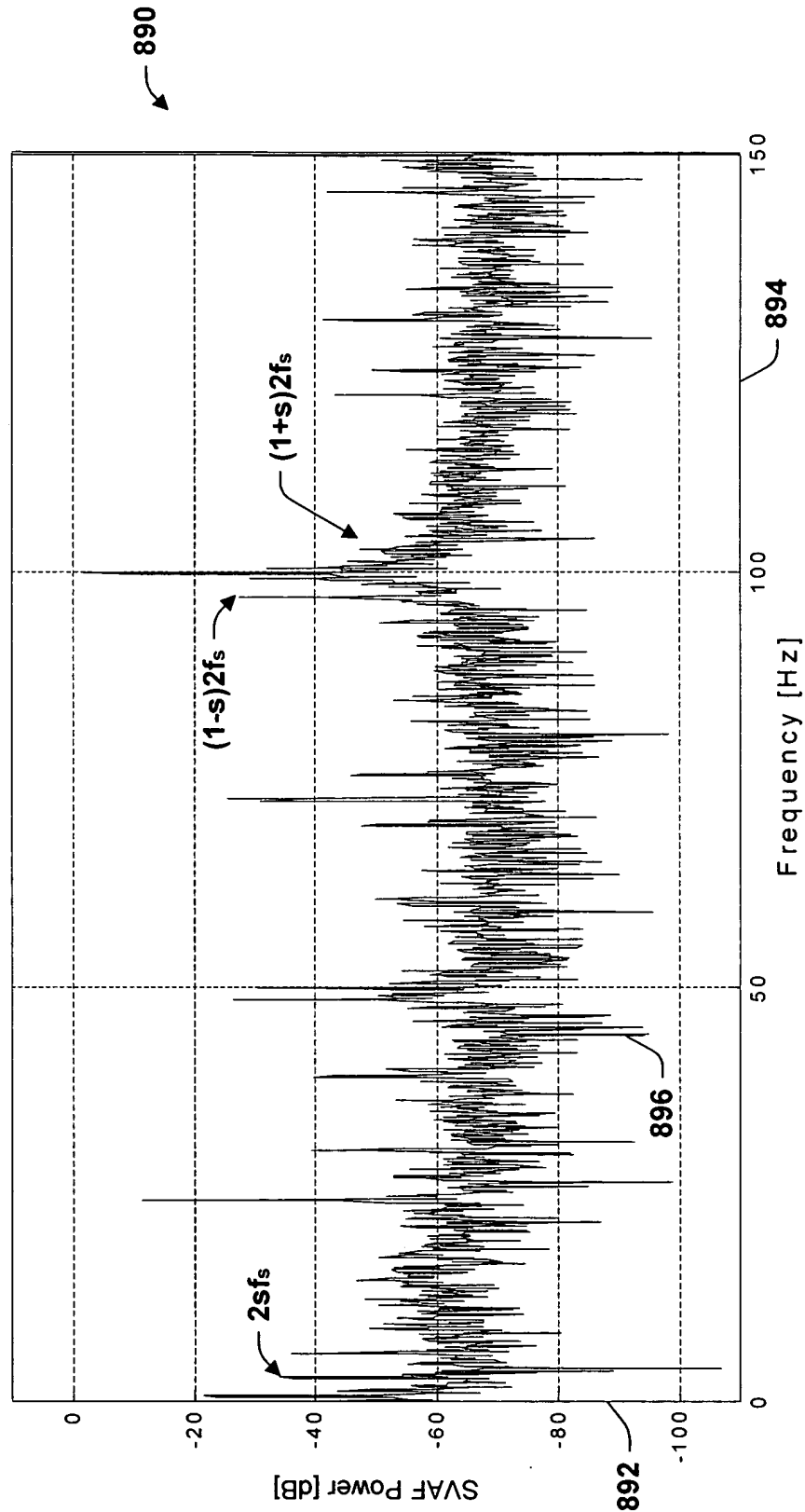


FIG. 44